140

PLASTICS AND RUBBER IN CHEMICAL PLANT

Manufacturing Chemist

incorporating
MANUFACTURING PERFUMER

Vol. XXX No. 6 — A PUBLICATION OF THE LEONARD HILL TECHNICAL GROUP — JUNE, 1959

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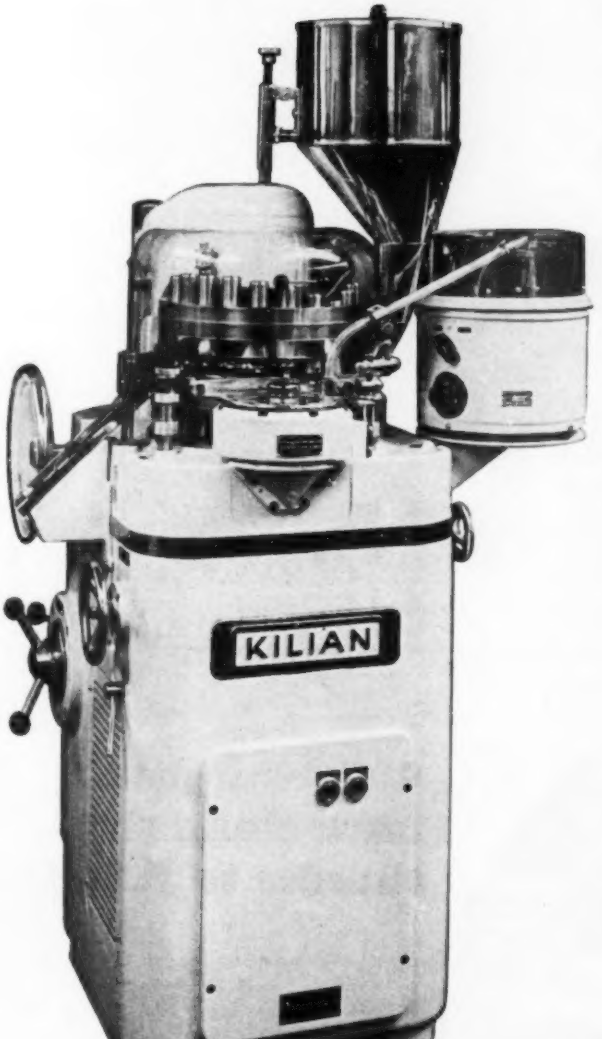

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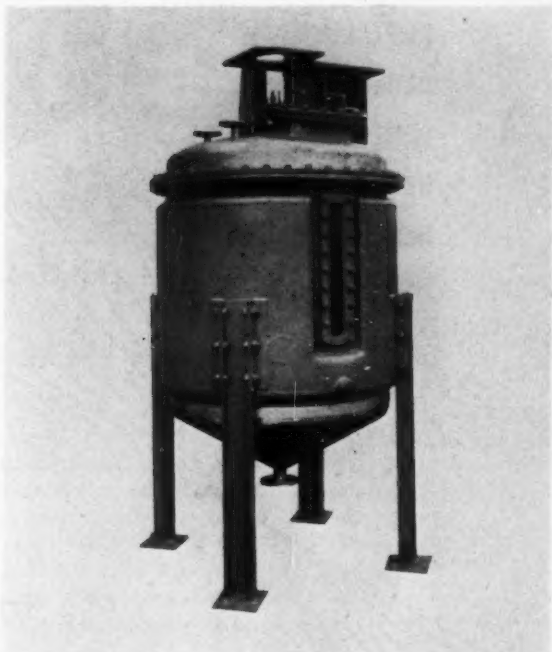

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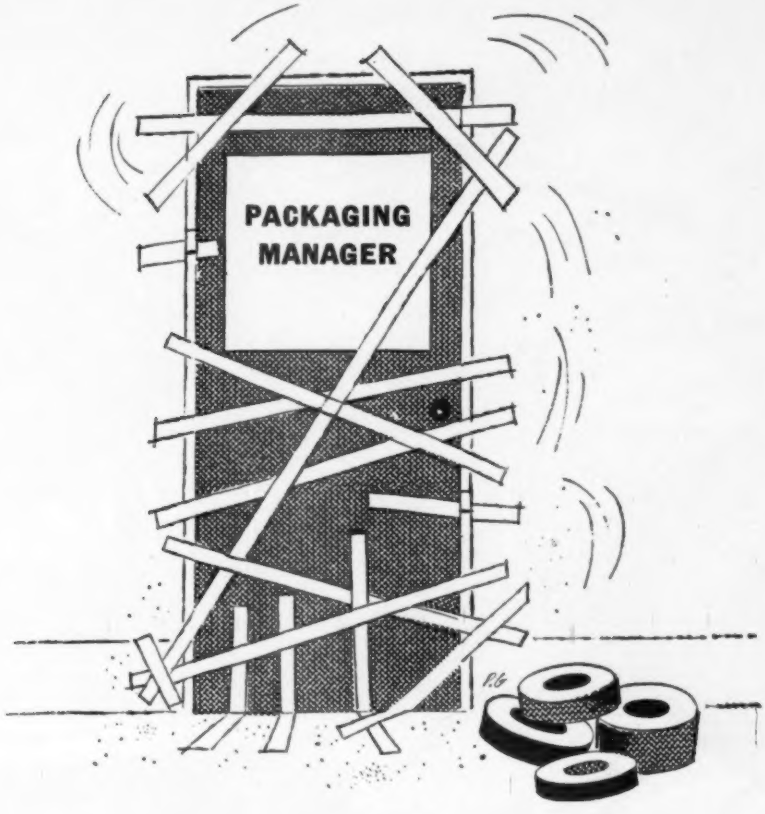
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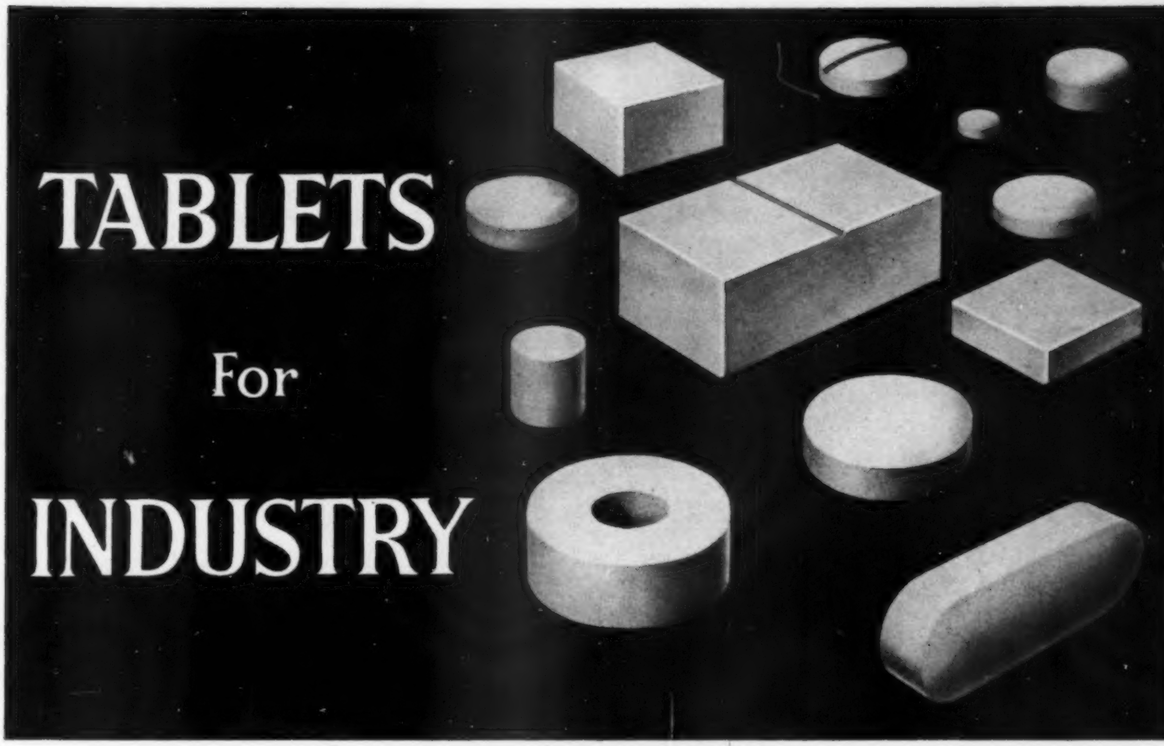

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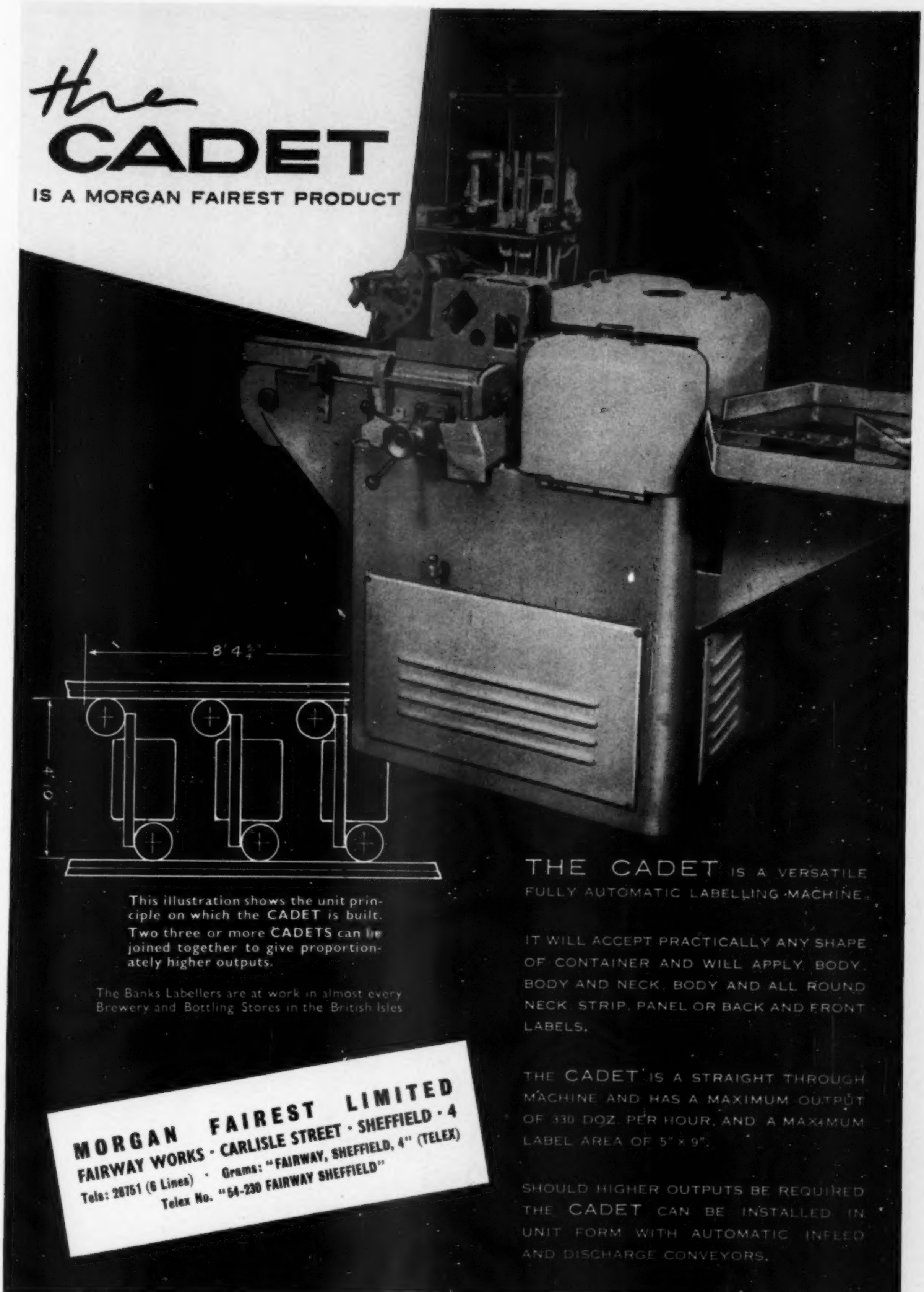

the
CADET
IS A MORGAN FAIREST PRODUCT
8' 4¼"
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This illustration shows the unit principle on which the CADET is built. Two three or more CADETS can be joined together to give proportionately higher outputs.
The Banks Labellers are at work in almost every Brewery and Bottling Stores in the British Isles
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THE CADET IS A VERSATILE FULLY AUTOMATIC LABELLING MACHINE.
IT WILL ACCEPT PRACTICALLY ANY SHAPE OF CONTAINER AND WILL APPLY BODY, BODY AND NECK, BODY AND ALL ROUND NECK STRIP, PANEL OR BACK AND FRONT LABELS.
THE CADET IS A STRAIGHT THROUGH MACHINE AND HAS A MAXIMUM OUTPUT OF 330 DOZ. PER HOUR, AND A MAXIMUM LABEL AREA OF 5" x 9".
SHOULD HIGHER OUTPUTS BE REQUIRED THE CADET CAN BE INSTALLED IN UNIT FORM WITH AUTOMATIC INFEED AND DISCHARGE CONVEYORS.

Troublesome Liquids need

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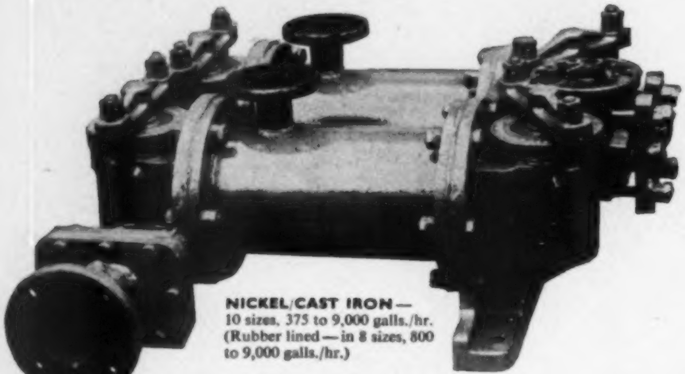

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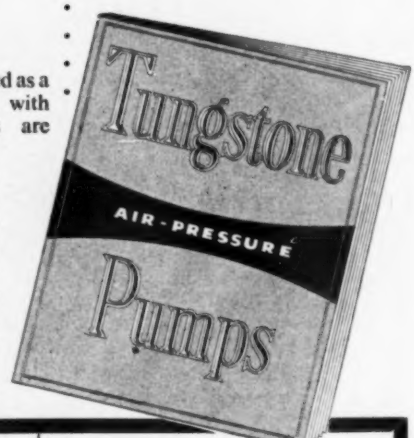
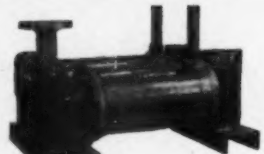


Which particular liquid in your business presents its pumping problem? Is it an acid, a slurry, a sludge . . . gritty greasy, corrosive, erosive, sticky? A TUNGSTONE Pump will quickly take care of that—as many industries have proved.

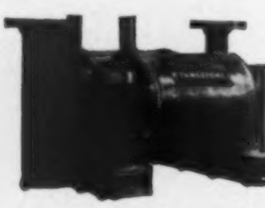
These fine pumps specially evolved for the handling of 'awkward' liquids have two valuable features: (a) the unit can be supplied in a range of materials which resist corrosion by any particular liquid, (b) there are no packings or glands within the unit and there is nothing to clog or choke—air is used as a piston, although it never mixes with the liquid: maintenance costs are negligible.

For any given pumping pressure the volume of air going to the pump can be controlled so that the pump's output can be varied from zero to maximum. The pump and whole length of delivery pipe containing valuable liquid can be emptied after each operation at the end of a shift.

EBONITE PUMP, non-immersion type. Made in 3 sizes: 200, 375, 600 gallons/hour.

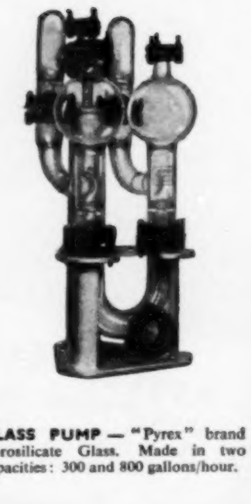


LEAD PUMP—immersion type. Made in 8 capacities: 375, 600, 800, 1,200, 1,500, 2,000, 3,000, 3,600 gallons/hour.



non-immersion **LEAD PUMP.** Made in 8 capacities: 375, 600, 800, 1,200, 1,500, 2,000 3,000, 3,600 gallons/hour.

EBONITE PUMP, immersion type. Made in 3 sizes: 200, 375, 600 gallons/hour.



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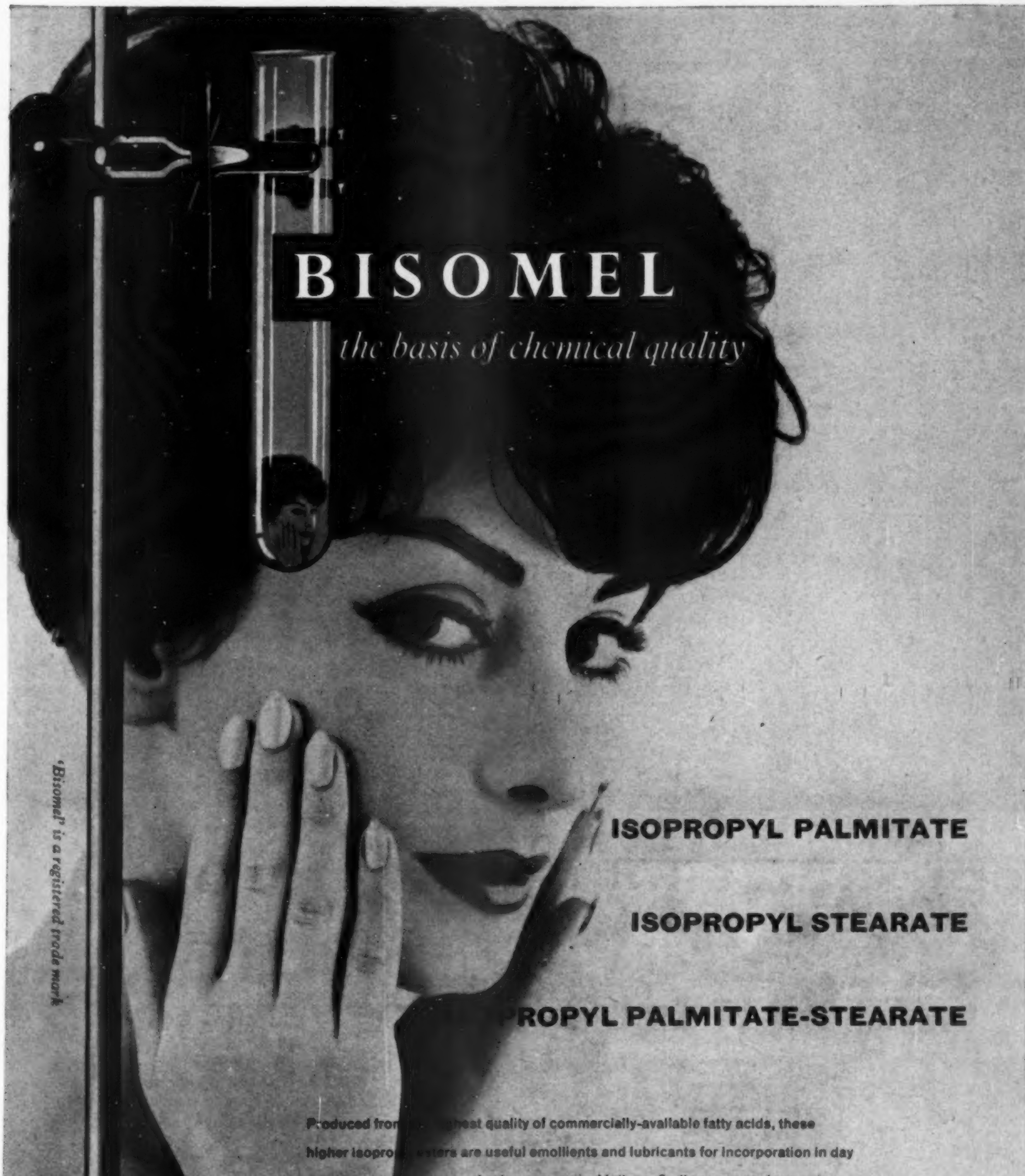

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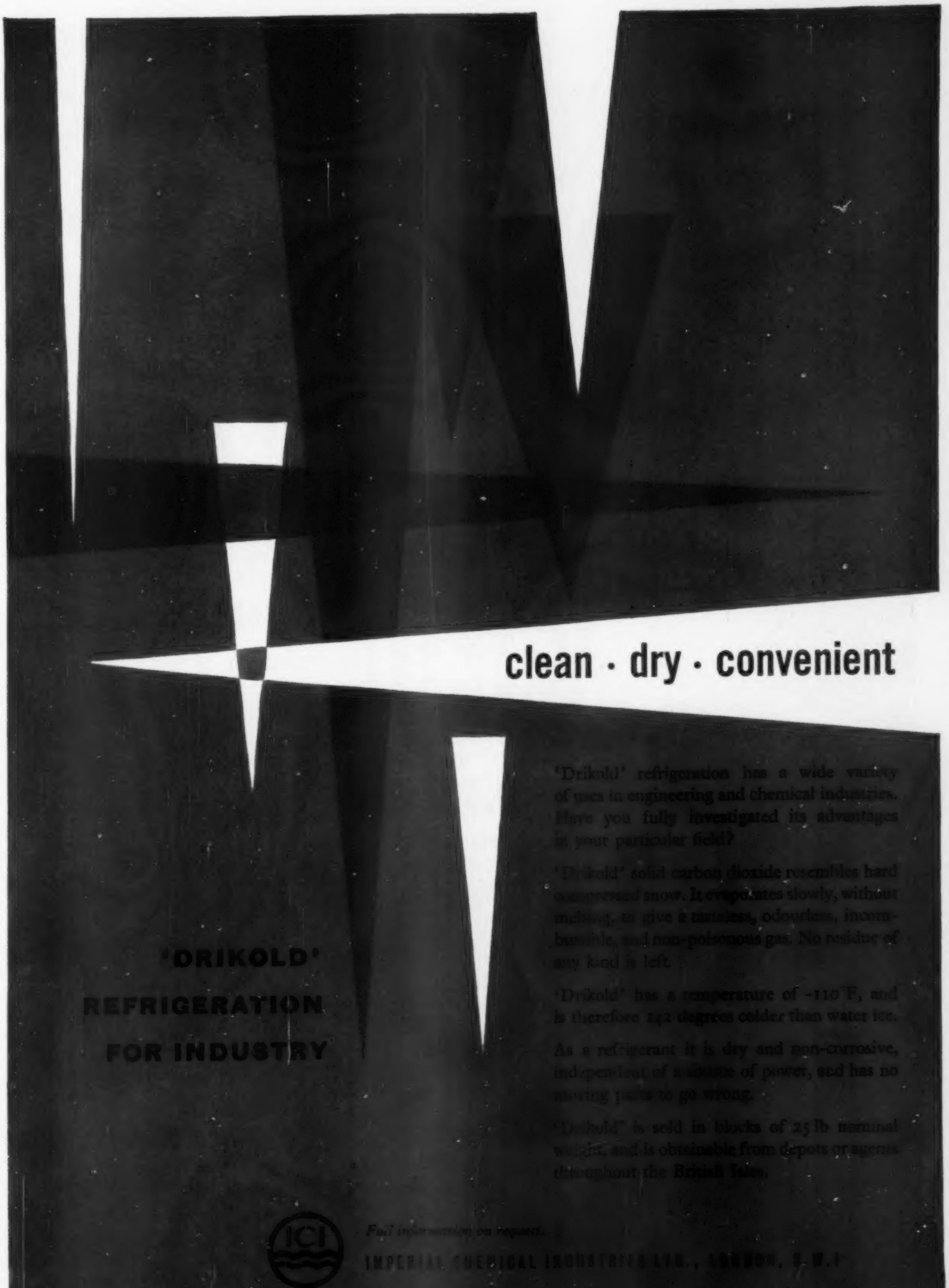
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'Drikold' refrigeration has a wide variety of uses in engineering and chemical industries. Have you fully investigated its advantages in your particular field?
'Drikold' solid carbon dioxide resembles hard compressed snow. It evaporates slowly, without melting, to give a tasteless, odourless, incombustible, and non-poisonous gas. No residue of any kind is left.
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FOR INDUSTRY
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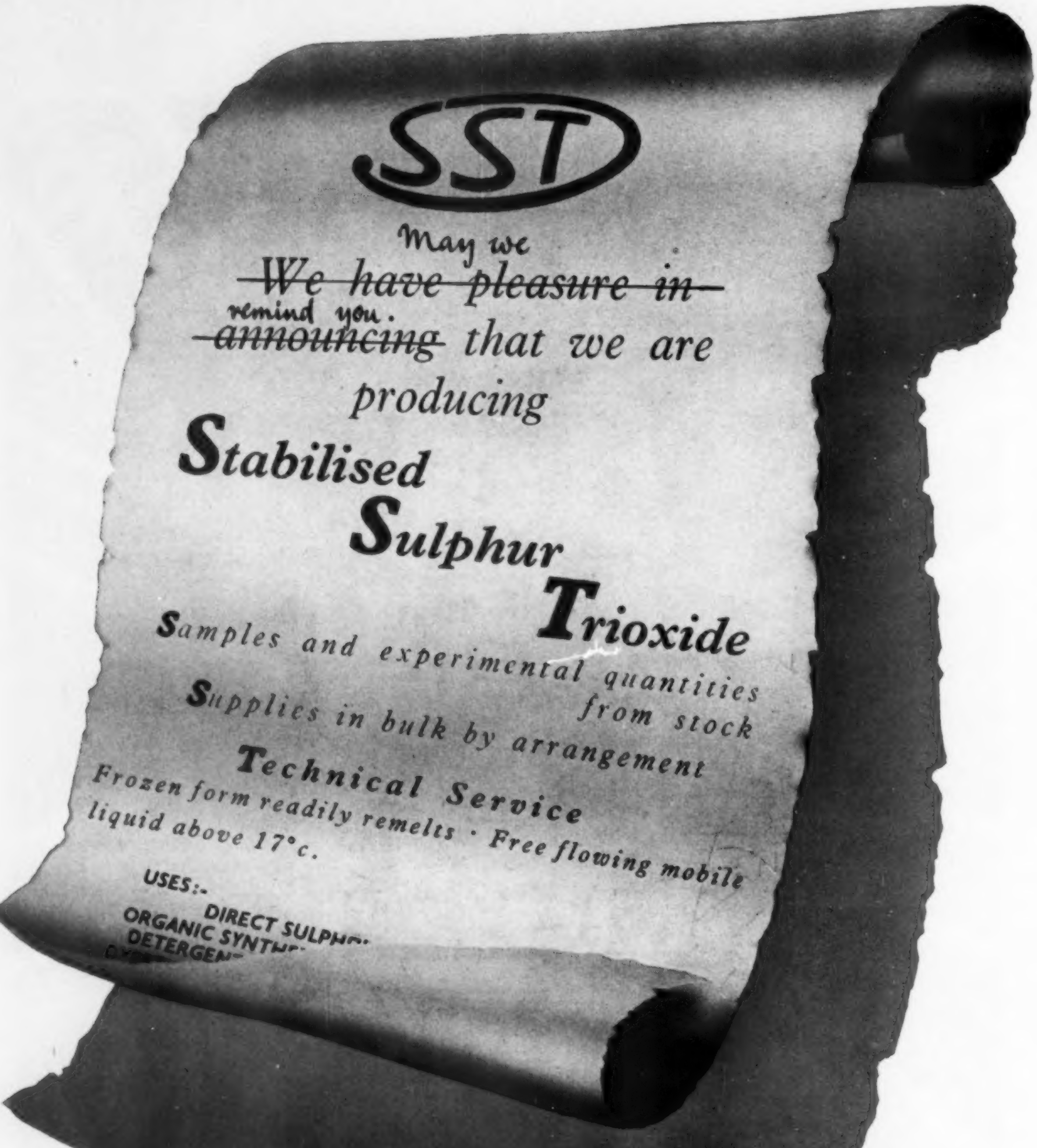

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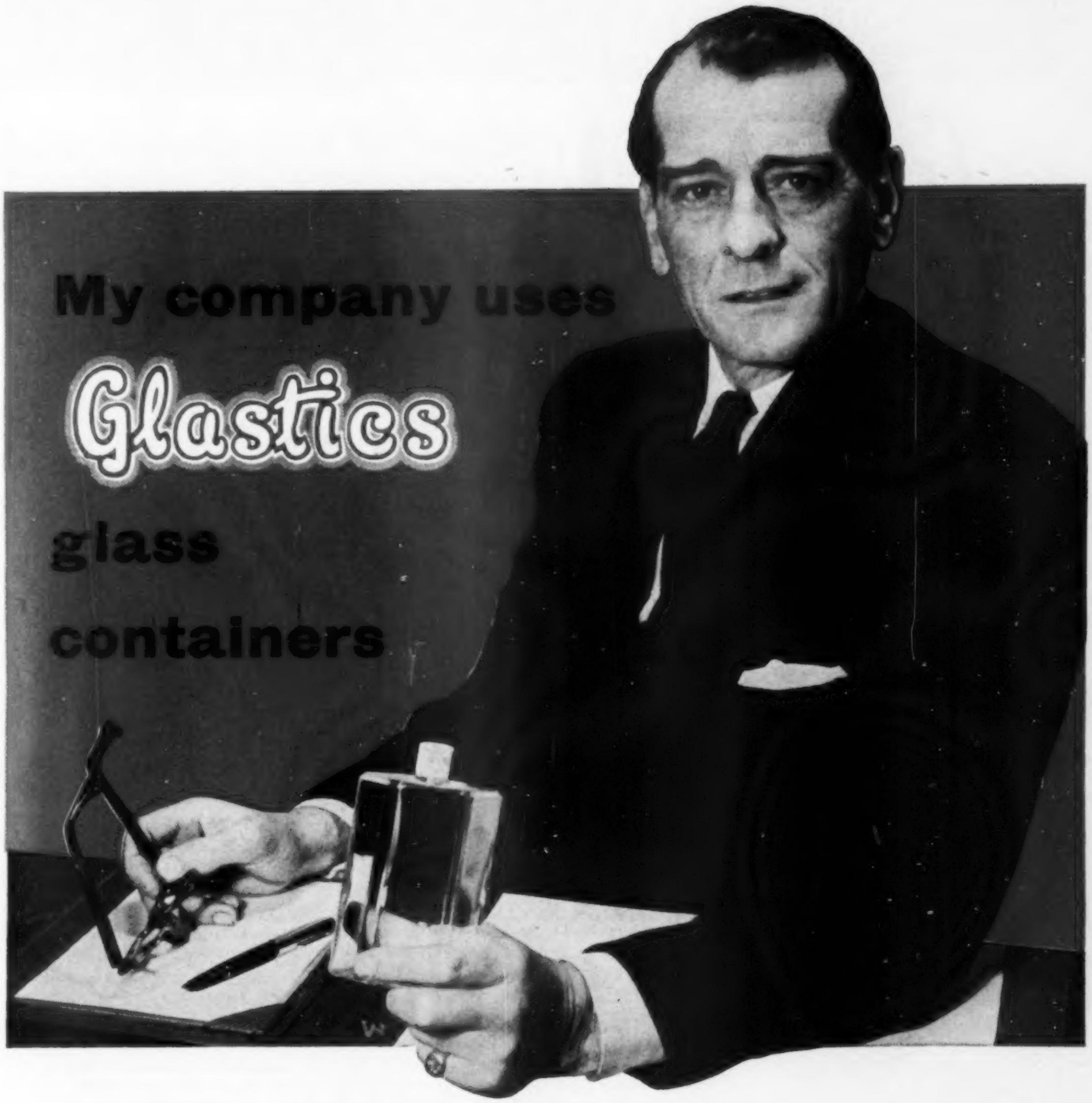

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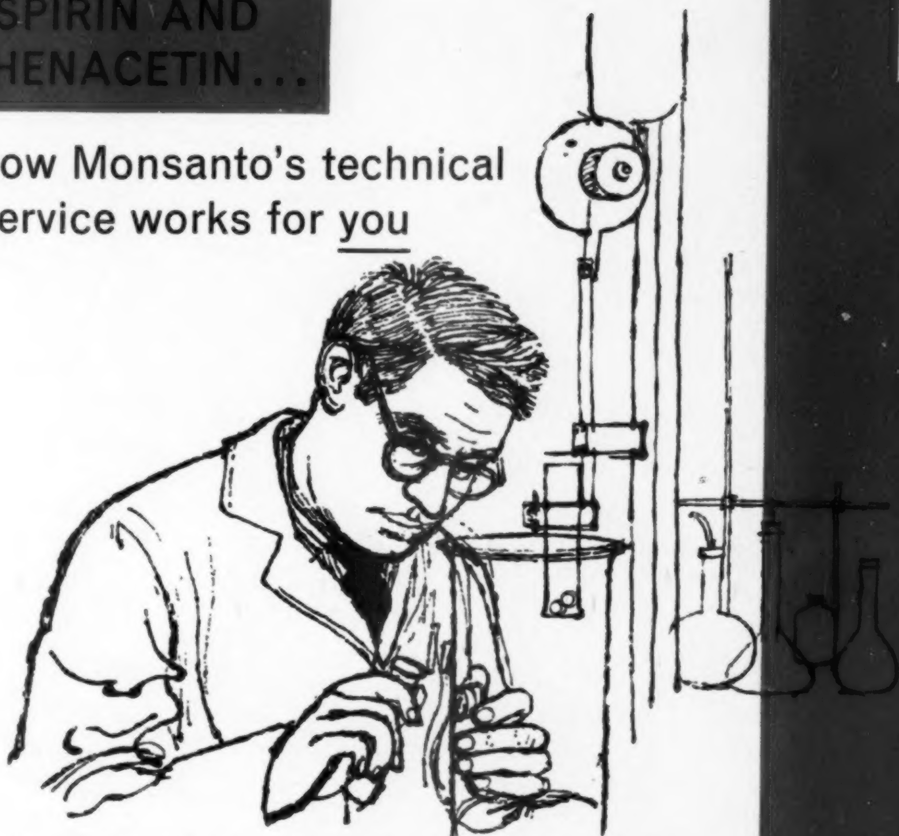
ASPIRIN AND PHENACETIN...

how Monsanto's technical service works for you



Monsanto chemicals help industry – to bring a better future closer

An outstanding technical service is offered to all buyers of Monsanto Aspirin and Phenacetin. This is designed to iron out the problems involved in the manufacture of tablets containing aspirin and/or phenacetin.

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Monsanto Aspirin is available in crystals for direct tableting —eliminates slugging and wet granulation.

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We also welcome your enquiries for the following imported products which are manufactured by Monsanto Chemical Company, U.S.A.: Methapyrilene Hydrochloride. Methapyrilene Fumarate.

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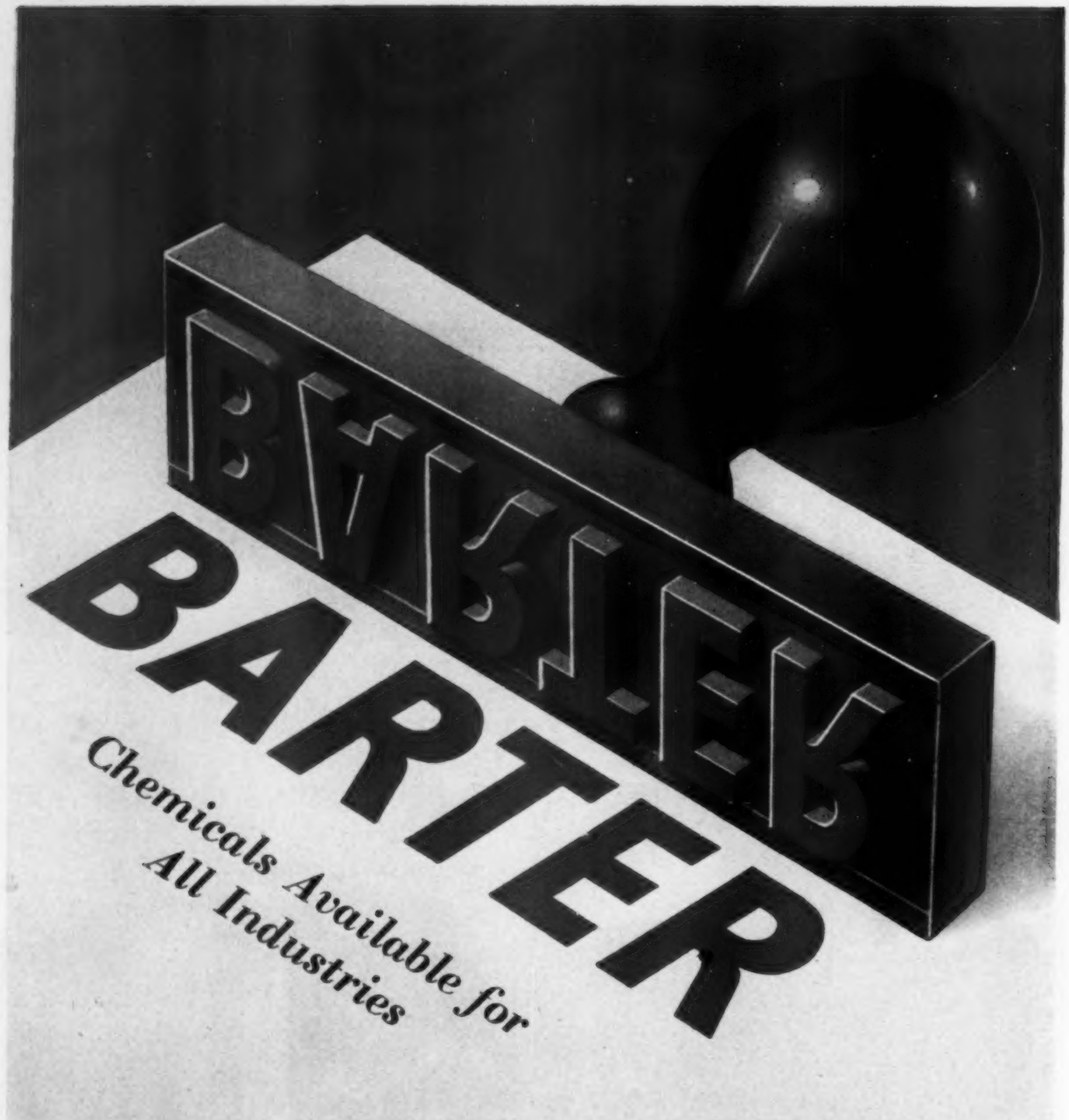
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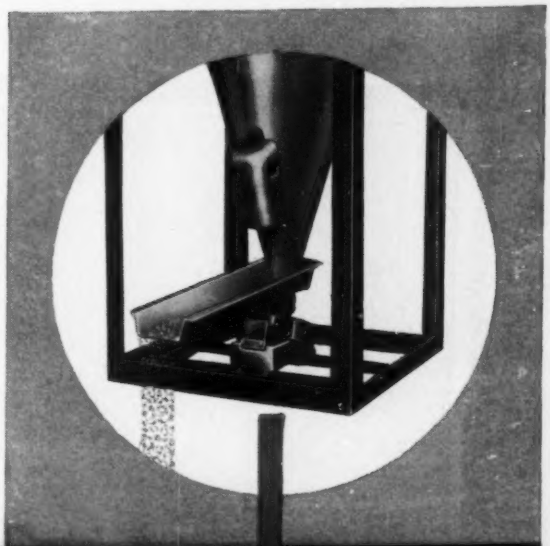
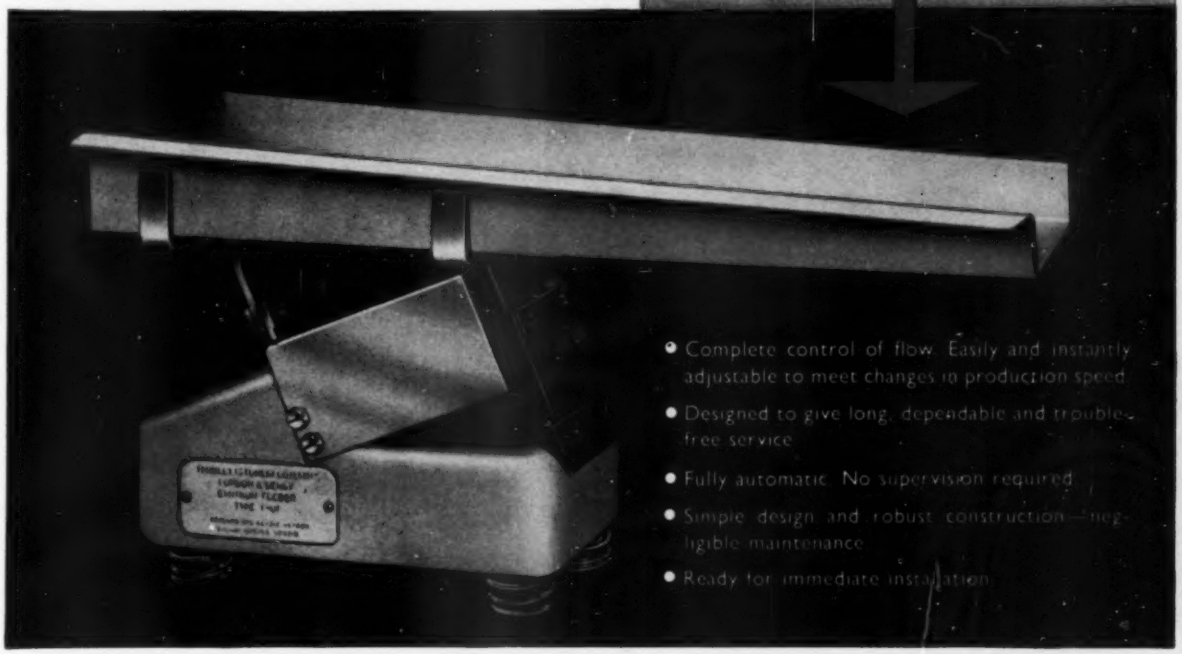


Model FO-1 feeder controls the flow of materials from the merest trickle up to 2 tons per hour. It eliminates the possibility of work stoppages or slow downs due to over-feeding or underfeeding. Compact and easily adapted to many functions, this model is widely used to deliver materials to automatic weighing machines, where steady feeding is essential.



SYNTRON *KEEPS THINGS MOVING*

Full comprehensive after-sales service is available from service depots at Birmingham, Bristol, Glasgow, Leeds, Manchester, Melton Mowbray and Newcastle-on-Tyne.

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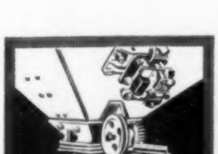
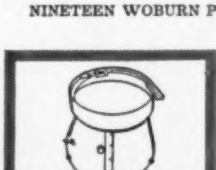
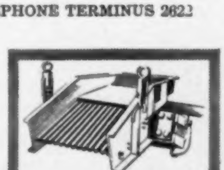


Syntron Electric Vibrators keep bins, hoppers and chutes clear with adjustable electro-magnetic vibration.



Bowl Feeders for orientating and feeding of small components, bottle caps, tablets, nuts, bolts etc.

Syntron Trough Feeders for use where materials must be carried over distances.



Syntron Heavy Tonnage Feeders are robust units capable of handling up to 750 tons per hour.

Syntron Packers provide a fast and efficient means of compacting and settling products in containers.

TGA 517

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PRESSING

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Press Button Containers

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Is your product in need of a new presentation? It may be that these modern packs will provide a gratifying boost towards higher and higher sales turnover.

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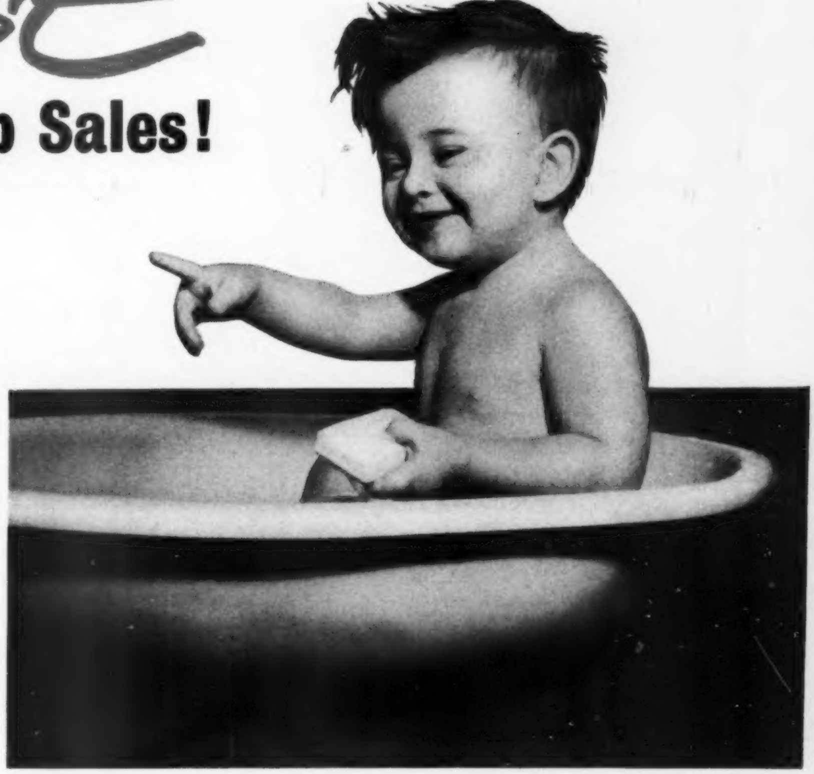
Wholly advantageous in TOILET SOAP

Let LORAMINE *Boost* *your* Toilet Soap Sales!



For the first time, here is an additive (patents applied for) that improves all the desirable properties of Toilet Soaps, without detracting from any one other property.

Perfume Fixation—LORAMINE powerfully fixes even the light, floral odours—in the tablet and on the skin.

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* **LORAMINE** is the registered trade name for products by

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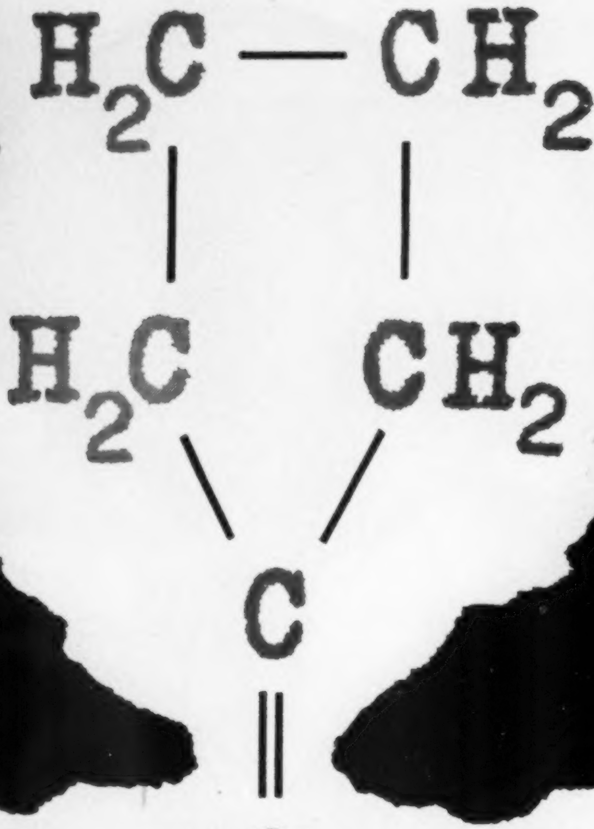

Assay	99%
Acid value (mg. KOH/gm.)	0.4 max.
Specific Gravity @ 15°C	0.946/0.948
Refractive Index @ 25°C	1.4344/1.4347
Colour (Lovibond units in 5¼" cell)	1.5 Yellow max. 0.7 Red max.
Boiling Range	129/131°C

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Price's now offer Cyclopentanone of guaranteed quality in commercial quantities. This colourless mobile liquid is of interest as:—

Perfumery and Flavouring Intermediate. Cyclopentanone undergoes a number of reactions including self-condensation and condensation with carbonyl compounds, alkylation, halogenation and hydroxylation, giving rise to a series of compounds of interest to the Perfumery and Flavouring Industries.

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General Solvent. Particularly in the Plastics Industry and in the manufacture of Paint Strippers.

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Manufacturing Chemist

Vol. XXX, No. 6 JUNE, 1959

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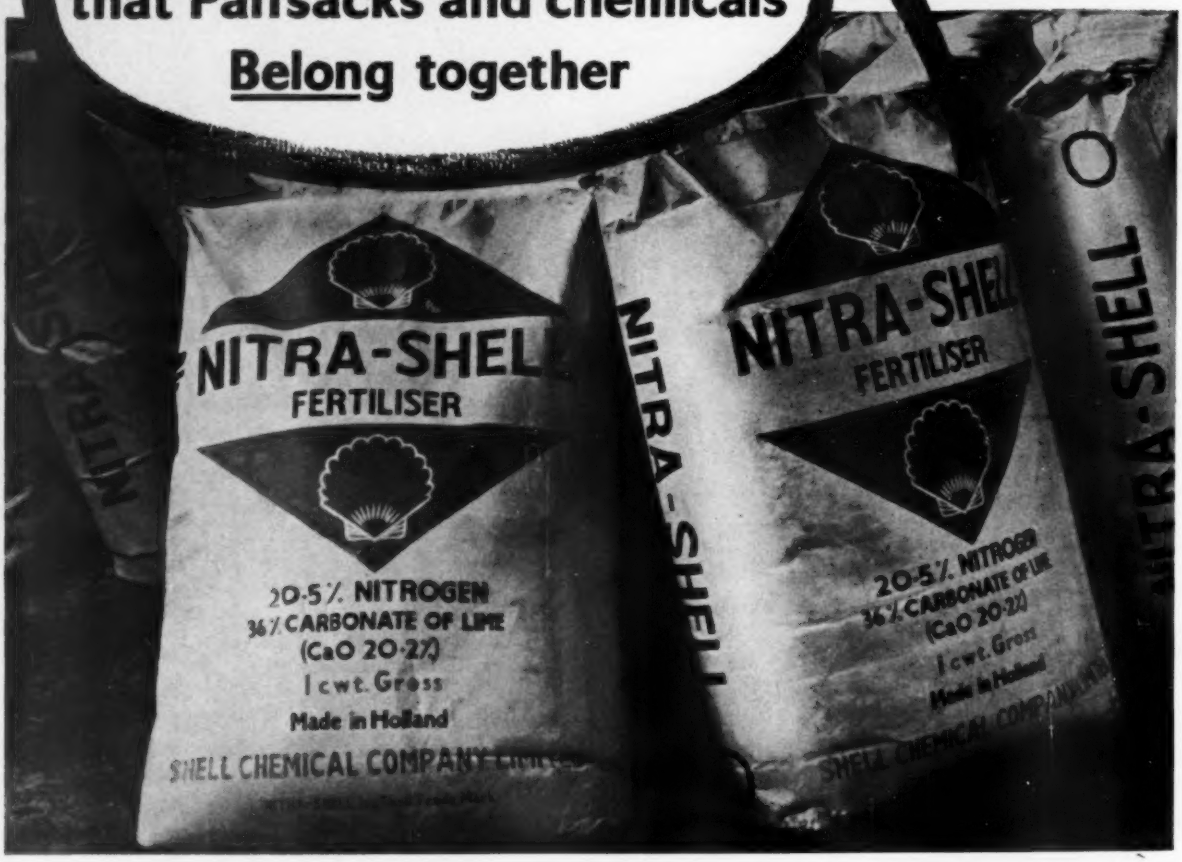
PROVED –

that Palfsacks and chemicals Belong together



Look at these sacks. They're PALFSACKS — multi-wall paper sacks by William Palfrey — each one filled with Shell Chemicals' NITRA-SHELL Fertiliser. And why do Shell Chemicals use PALFSACKS? Here is their own statement:

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On examination, neither bags nor contents showed any deterioration."

No doubt about it, if you want to give YOUR chemicals the perfect protection they deserve — pack them in PALFSACKS.

Not just paper sacks – but

PALFSACKS

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TOPICS AND COMMENTS

Critically and with discrimination

THE pharmaceutical industry emerges rather well from the Hinchcliffe Committee's final report on the cost of prescribing in the Health Service.* True there are digs at firms who make big profits and do no research—being content to duplicate existing products—and there are criticisms of expensive sales promotion, but on the whole these admonitions are balanced by a sympathetic and honest appreciation of the industry's problems. As the Committee say, there must be very few industries in which it is possible for a firm to lose a market so quickly as in the pharmaceutical industry. The drug of choice today may be completely ousted by a newcomer tomorrow. Hence the need for more and more research. The industry's outlay of £4 million p.a. is considered inadequate compared with Switzerland's £7 million and the United States' £48 million. Why is pharmaceutical research so expensive? In their 100-page report the Committee devote ten pages to an admirably concise popular exposition of pharmaceutical research, complete with historical references ranging from the sulphonamides to cortisone. The short answer to the question of research costs is that it is not possible for any organic chemist to write down the formula of a new drug and guarantee that it will be a cure for any specific disease. Of course this is obvious to anyone with even a slight knowledge of pharmacology, but it is not clear to the many millions who pay for the Health Service (and benefit from it). With these ten pages alone the report renders a valuable service to the drug industry. The Committee's conclusion on research is that pricing arrangements between the Ministry of Health and the industry should be designed to make full allowance for genuine research expenditure so as to enable a vital industry to make its maximum contribution to the development of drug therapy. But at the same time these arrangements should discourage extravagant overheads and sales promotion. The voluntary price regulation scheme, it is revealed, is now saving the Exchequer just under £400,000 p.a.

While the Committee found no evidence of widespread and irresponsible extravagance in prescribing they think there is scope for economy. For instance, some waste is involved in the present tendency to order larger quantities on each prescription. There is even a hint that some doctors prescribe extravagantly in order to attract patients. But the major obstacle to economical prescribing seems to be the inability of the average practitioner to judge the validity of the maker's claims for many new drugs now produced. Considering that there are now something over 8,500 preparations prescribable under the N.H.S., it is not surprising that the average doctor finds it so hard to keep up to date. Thus there is a "clamant" need for systematic post-graduate instruction of G.P.s in pharmacology and therapeutics. More refresher courses on problems of prescribing would be one remedy. There should be a new "Prescriber's Journal"—produced by "appropriate professional bodies" to replace the present "Prescriber's Notes" issued by the Ministry. While it is thought to be wrong to restrict doctors to a limited range of drugs, the Minister is urged to reach agreement with the professional bodies concerned on voluntarily limiting the amount of drugs on each prescription to one week's supply or less, except in chronic or special cases, this arrangement to have a trial period of two years.

The public are exhorted not to press their doctors for particular drugs, frequently expensive ones. They are asked to accept the doctor's advice and guidance as a real contribution to their welfare without the artificial addition of an unscientific placebo. They are warned not to get the medicine habit.

The Committee's thorough and painstaking analysis of prescribing costs—which runs to over 50,000 words—naturally included a study of distribution through retail pharmacists. Their conclusion is that there is no satisfactory alternative to the present system of supplying N.H.S. medicines through the established retail channels. Any other system, such as special dispensaries, would raise costs. However, the Ministry of Health is criticised for allowing pharmacists to make unintended profits by buying at below the Drug Tariff rates at which they are reimbursed. The pharmacists are not to blame for doing this—indeed, say the Committee, they should be encouraged to buy at below Drug Tariff rates whenever they can. "But those responsible for administering the pharmaceutical service should surely have sufficient business acumen to ensure that the taxpayer shared in some of the savings which could be made." It is certainly astonishing that while the Ministry has advisory committees on technical and professional matters, it has neglected to get proper advice on the economic and business side of the Service. Therefore, a major recommendation is that an Economic Advisory Committee should be set up to advise the Minister expeditiously on pharmaceutical service costs.

If this is the major recommendation of a committee that has been studying pharmaceutical

* Final report of the committee on cost of prescribing, H.M.S.O. 6s. net.

costs for two years one may wonder whether it was all worth while. The answer lies in the report itself—an admirably fair and thorough document which deserves the closest study by everyone, not least the public and the politicians. And here a word of praise for the lucid and easy style in which it is written. Once again the plain fact is rammed home that the comprehensive Health Service the nation wants cannot be provided on the cheap. And here it may be asked whether £626 millions or so a year is in fact such a high price to pay for a Service which confers such tremendous benefits on a nation of 50 millions? Nevertheless all forms of waste must be relentlessly extirpated if the Health Service is to continue in the form which the nation has grown to expect. To dispense the benefits of the Service "critically and with discrimination" must be the paramount aim of all concerned.

The world wants British chemical plant

SINCE it would be unwise to assume that capital expenditure in the U.K. chemical industry will continue at the record levels of 1957 and 1958, the British Chemical Plant Manufacturers Association is urging its members to increase their exports still further. In the past three years the export trend has been very encouraging, the value of chemical plant exports in 1958 being £14·96 million against £10·47 m. in 1957 and £8·57 m. in 1956. In two categories—gas and chemical machinery and plastics and rubber working machinery—exports have more than doubled in quantity and value since 1956. A smaller category which has done well is tableting and pelleting presses—from £130,000 in 1956 to £220,000 in 1958.

The Commonwealth is the best customer, taking 69% by quantity and 61% by value of all U.K. chemical plant exports. India continues to be an excellent customer. The industry is bound to benefit by the easing of strategic export controls which lifts the embargo on exports to the Soviet Bloc and China from all petroleum refining equipment and petrochemical plant, most types of vacuum pumps, compressors and blowers, and all equipment for the production of lubricants.

Unfortunately the bright picture of prosperity is darkened by the continuing failure of some manufacturers and suppliers to keep to delivery dates. The customers who are most dissatisfied are the industry's most important ones—the British chemical and allied industries. According to their annual report, the B.C.P.M.A. executive committee take a very serious view of these complaints of broken promises and, in some cases, unsatisfactory after-sales service and are pressing their members hard to do better. The counter charge, of course, is that some customers take far too long to approve designs and finished drawings, that they do not take suppliers sufficiently into their confidence, and that they specify delivery dates which do not correspond with their actual production programmes. It would indeed be remarkable if all faults lay on one side only but it is unfortunate that thirteen years after the end of the war there is still room for complaints that belong to a long-past era of material and labour shortages. If chemical plant manufacturers really want to increase their exports they must improve their delivery reputation at home so that it matches their reputation for first class engineering and design.

Ethical promotion for ethicals

THE reaction of the Association of British Pharmaceutical Industry to criticism of excessively pushful or downright misleading methods of sales promotion has been to draw up a formal Code of marketing practice for medical specialities. This Code supersedes a code of advertising practice first adopted by the medical specialities section of the Association in January 1946. It has been designed for present-day conditions, including the existence of the National Health Service, and it has been accepted by every member of the Association and not just one section. Furthermore it has been agreed that any member violating the Code renders himself liable to expulsion.

The general principles of the Code are simply that all information used for sales promotion must be both accurate *and* complete, and that selling methods must at all times be appropriate to the learning and professional status of the customers—doctors and pharmacists. For instance, it is laid down that there must be unequivocal differentiation between statements and claims based on evidence and those based on speculation. This rule might have gone even farther and excluded speculation entirely.

With an eye on the hazards of excessive prescribing, another rule states "The phrase 'freely prescribable under the N.H.S.' and similar phrases using the ambiguous word 'freely' must be avoided." It is also laid down that the basic N.H.S. cost of products must be given in or with all medical product literature except where reference to cost would be inappropriate. Any purchase tax chargeable must be indicated.

Doctors must not be pestered with excessive mailings and when they ask to be removed from mailing lists this request must be honoured. In any case mailings lists must be carefully compiled and frequently revised to ensure that literature is not sent to doctors unlikely to obtain useful information from it.

There are three rules for medical representatives: 1. they must be properly trained to give the technical service expected of them, 2. they must not use bribes or subterfuges to get interviews, 3. they must not call so often that they become nuisances.

Samples, except supplies for clinical trials, must be modest in size and face value and unsolicited samples of normally harmless products must be

small enough not to be dangerous to children. Samples of dangerous products must only be sent on request and must be packed to be reasonably secure against opening by young children.

There are two rules on gifts and hospitality; they must be moderate, of little monetary value and at all times strictly relevant to the practice of medicine and pharmacy. Finally, manufacturers are asked to refuse to give information on personal medical matters to the lay public and to refer enquirers to their own doctors.

Most members of the A.B.P.I. no doubt already enforce these standards or even higher ones, but for those who may err the new Code will be a valuable corrective because, of course, the isolated offences of the few tend to denigrate the many. Furthermore it will prevent less scrupulous firms from gaining an unfair advantage over their more ethical competitors. It is to be hoped that it will never be necessary to apply the penalty of expulsion to any member.

Five year plan for research

THE reorganisation and expansion of the work of the Department of Scientific and Industrial Research continues apace. The five-year programme announced last month will cost £61 million compared with £36 million spent during 1954-59. In the first year it is expected that expenditure will be about £9 million, rising to £14 million in 1963-64. The money will be spent on increasing the work of the D.S.I.R.'s own research stations, on increasing grants for research and training in universities, and on increasing grants to the 46 research associations supported jointly by the Department and by industry.

The Research Council appointed in 1957 to reorganise the D.S.I.R. has made a number of changes in the Department's research stations which between them receive most of its funds. The Fuel Research Station has been closed down and some of its work transferred to the new Warren Spring Laboratory at Stevenage, which will initially work chiefly on process research and chemical engineering. Three stations—the Ditton Laboratory, the Low Temperature Research Station and the Pest Infestation Laboratory—have been transferred to the Agricultural Research Council, since they work chiefly on agricultural products. The Tropical Research Institute (formerly the Colonial Products Research Institute) has been transferred to the Department from the Colonial Office, and will continue to work on the exploitation of tropical plant and animal products.

A considerable reorganisation has been made of the work of the former Chemical Research Laboratory at Teddington. Its new name—the National Chemical Laboratory—has been chosen to emphasise that it exists not to cover the whole field of basic chemical research but to undertake special projects not appropriate to any other organisation. The programme of work has been concentrated on a few limited objectives, including the determination of the physico-chemical properties of materials and corrosion research. Chemical engineering research is to be transferred to the Warren Spring Laboratory, microbiology, including the National Collection of Industrial Bacteria, is to be transferred in part to the Torry Research Station, and high polymer research is to be reduced and concentrated on electrodialysis membranes.

The biggest proportional increase in D.S.I.R. expenditure will be on grants to students for postgraduate training and on grants to universities for special researches. In 1957-58 nearly a million pounds were spent on studentships and research grants. It is now proposed to increase the number of studentships from 1,000 to 1,900 and to increase research grants three or fourfold. A great number of research projects are now being supported in 20 universities and five technical colleges. They range from a £640 study of ionising radiations and chemical systems at Salford Technical College to a £355,000 liquid hydrogen bubble chamber which is being built at Imperial College. It is expected that by 1964 10% of D.S.I.R. funds will be going to the universities.

More money for industry

THE grant-aided research stations received about £1·73 million of D.S.I.R. funds in 1957-58. Over the next five years these grants are going to be increased by about one-third, but it is assumed that the industries which the associations serve will also increase their contributions by 46%. Additional help for industry is proposed in the form of aid for industrial research and development projects which the inventors themselves cannot support adequately. This appears to be another form of the kind of Government aid for inventions which the National Research Development Corporation dispenses. Speaking about this, Sir Harry Jephcott, chairman of the Research Council, said it was an entirely new idea for the D.S.I.R. and one which might prove to be most valuable. Both large and small firms are eligible for aid—provided the proposed projects are likely to lead to results "of value to the nation as a whole."

Another important job which the Department is undertaking is the development of the National Lending Library for Science and Technology at Thorp Arch, near Leeds. It is hoped that this will be functioning fully by 1962 and making a valuable contribution to the wider and more effective dissemination of technical information.

The new Research Council deserve congratulation for persuading the Treasury to spend a great deal more on civil research. The plan appears to allocate the money in ways which should give the quickest returns in research results. It is to be hoped that those who have the responsibility for spending such large sums of public money will constantly keep this desirable end in mind.

Drugs from xerophilics

XEROPHILOUS plants like cacti, yuccas and agaves are put forward as the latest sources of cortisones and other drugs. It is thought that the active agents in these desert plants are formed by their drought-resisting mechanisms. According to R. R. Cruse, a chemist at the Southwest Research Institute, San Antonia, Texas, cortisone-producing materials are present in several yuccas and agaves and they are thought to exist in prickly pears. More startling is the claim that an extract from prickly pears has insulin-like properties but has the advantage that it can be administered orally. Apparently it is being clinically tested, because Mr. Cruse told the American Chemical Society that no untoward side effects have been reported.

Other possible therapeutic sources are the agave lecheguilla which is reported to secrete a tuberculostatic, the Argentine mesquite which is said to provide a substance effective against *Staph. aureus*, and the roots of the yucca which have yielded extracts which are being screened for tumour-inhibiting action.

The great natural advantage of these plants is that they grow under adverse conditions on marginal land—on deserts, in fact.

£30,000 for distillation studies

THE first fruits of a co-operative effort by the users and makers of chemical plant to find gaps in chemical engineering information is a report recommending six basic researches in distillation. Six research contracts worth £10,000 p.a. have been negotiated with the universities of London, Birmingham, Manchester and Swansea for a period of three years to carry out the projects. The money will be found by the members of the Association of British Chemical Manufacturers and the British Chemical Plant Manufacturers Association and the researches have already started. They will be co-ordinated by the Distillation Panel of the two associations which has been responsible for the report. However, the Universities have complete freedom of action and will publish their results so that all may benefit. In some cases the university workers have been given access to large-scale plant units to enable them to collect data which can only be obtained from such equipment.

In addition to fostering this closer link between the Universities and the two industries, the two Association Research Committees and the Distillation Panel have taken the initiative in collaborating with the Institution of Chemical Engineers in the organisation of an International Symposium on Distillation. This will be held in Brighton in May 1960.

The machinery created for the distillation work provides a continuing means of revealing troublesome gaps in chemical engineering knowledge and of closing these gaps by close liaison between industry, the universities and the professional institutions. Now that distillation has been dealt with a second A.B.C.M./B.C.P.M.A. panel has set to work on liquid/solid separation filtration and other panels will be formed as soon as the need has been established.

This co-operative system for discovering research needs and of providing the means of tackling them is quite new. By harnessing the joint resources of industry and the universities it is likely to be more effective than a large central research station which at one time was proposed for chemical engineering. Certainly it has the merit of making full and immediate use of existing facilities and to this extent it will probably save money.

The report of the distillation panel gives full details of the six research projects. It is available from the A.B.C.M. and the B.C.P.M.A.

The ubiquitous tube

IN SPITE of the appearance of toothpaste in pressure packs it is likely that collapsible metal tubes will continue to be the accepted form of packing and dispensing this essential toilet article. Indeed, more tubes are used for toothpaste than any other product because they are cheap, airtight and efficient. Collapsible tube manufacturers have spent a great deal of time and money on perfecting toothpaste tubes and can provide the right metals, protective lacquers and waxes for all formulations. The larger manufacturers, like Universal Metal Products Ltd., of Salford, have well-equipped laboratories for testing tubes and products and offer this service and expert advice free of charge.

The caps now used for tubes present a firm gripping surface, especially the flower-pot type which is now so popular. If accidentally dropped, they are large enough not to get into inaccessible places, and no time and temper are lost in finding them again.

Further examples of successful tube packaging are, of course, shaving cream, hand cream, face creams and liquid soap in tubes. A tube is easily and safely packed in a suitcase or carried in a handbag. It is light in weight and always ready for use. Furthermore the contents are always kept in good condition as the tube is airtight.

Metal tubes are also being increasingly used for the packaging of adhesives. With special nozzles which put the adhesive exactly where required and nowhere else, the job is done quickly and cleanly.

Manufacturers of shoe polish, furniture cream, etc., are also finding collapsible metal tubes the answer to their packaging problems.

Most metal tubes produced today are made from aluminium and are economically priced.

The filling of tubes presents no problem. Equipment ranging from inexpensive foot or hand-operated machines for the smaller firms, to the very high-speed machines which feed, automatically register, and combine all types of electronic devices, are in regular use in this country.

Hard Gelatin Capsules—How Eli Lilly

Make 500 Million a Year

Basingstoke plant is unique in Europe

By W. G. Norris

Eli Lilly and Co. Ltd. have been producing hard two-piece capsules at their Basingstoke factory for the past seven years. The plant is the only one of its kind in Europe and in it is carried out one of the most complex series of manipulative processes in the pharmaceutical industry. Here is a description of how it achieves an annual output of 500 million capsules, jewel-bright in a range of 40 colours.

MURDOCK of London described the first preparation of hard or telescoping gelatin capsules in the *London Journal of Arts* in 1848 and was later granted an English patent on their preparation, but it was in the United States that mechanised methods were applied to their production at the beginning of the present century. In the past 10 years there has been an increasing demand from both British firms and subsidiaries of American companies, and some years ago the demand increased to a point where it became worthwhile to manufacture hard gelatin capsules here. In 1952 Eli Lilly and Co. Ltd., the British branch of the American company, commenced production at their Basingstoke factory.

Lilly in the U.S. were pioneers in hard capsule manufacture and the plant at Basingstoke is believed to be the only one outside the U.S. It is now producing 500 million capsules a year. Six sizes are made, the largest No. 0 and the smallest No. 5. The largest is about 0·8 in. long and the smallest 0·45 in. Capacities differ according to the pressure employed in filling the contents. Sodium bicarbonate, for instance, would fill the six sizes at the rate of 11, 8, 6, 5, 4 and 2 grains.

Clear, opaque and coloured capsules are made at Basingstoke. Forty different colours are currently available and further variations are obtainable by having caps and bodies in contrasting colours, *e.g.* black and white, pink and clear, blue and brown and so on. Equipment for making bodies and caps in different colours has been installed only during the past eight months.

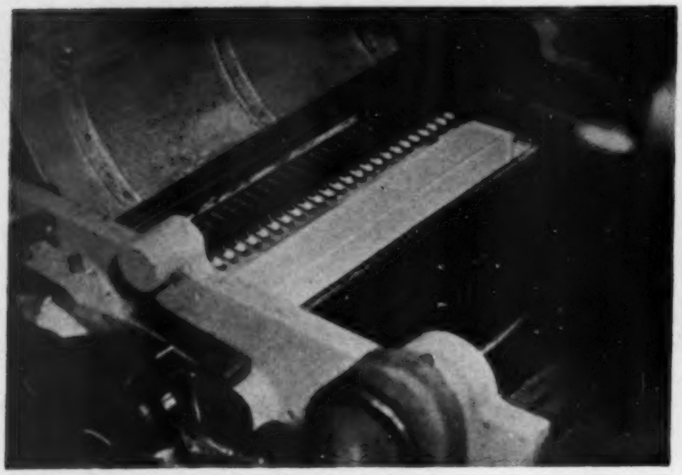
Uses of capsules

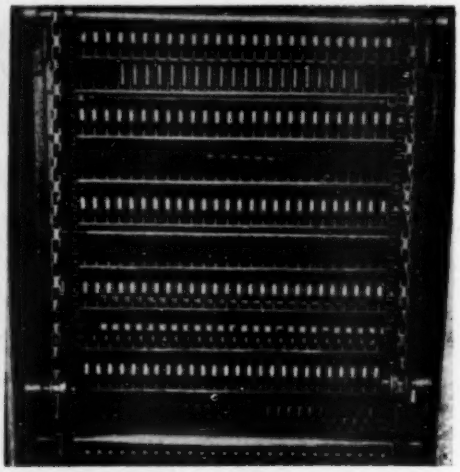
Hard capsules are used for a widening range of powdered drugs, including barbiturates, antibiotics, vitamins, analgesics and liver preparations. Lilly use many millions of capsules themselves and sell considerable quantities to other companies. They do not fill capsules for other manufacturers.

Lilly's current trade prices per thousand for empty capsules range from 22s. 4d. for No. 0 to 14s. for No. 5. To this must be added the cost of filling and finishing and, in some cases, banding. However, capsules are an elegant form of presentation and they have the practical advantage of disintegrating at a more uniform rate than tablets, the disintegration rate of which is necessarily dependent on the skill of the tablet maker. Some people also find capsules easier to swallow. Capsules are primarily identified by colour, but it is possible to emboss them or even to print on them, though at present Lilly in England do not do either.

Layout at Basingstoke

Lilly's premises at Basingstoke—in which about 400 people are now employed—are sited on a 13-acre plot just outside the town. The main building—consisting of five storeys and a basement—was completed just before the war. Several new buildings have been erected, one of which houses the capsule making plant. This covers some





Left: Close up of a pair of casting units. Each bar has 30 stainless steel pins, one set makes the bodies and the other the caps of the capsules. In this case clear bodies and opaque caps are being made and the bars are dipped into different pans. The pins are rotated in a blast of air to harden the gelatin. Right: One end of the kiln showing the capsules during the 45 min. drying cycle. The upper part of the kiln is fed with slightly warmed air. The lower part is at room temperature.

14,000 sq. ft. and includes preparation departments, a machine hall, sorting department, a large air conditioning plant and other services.

Air conditioning is of vital importance owing to the hygroscopicity of gelatin and the critical nature of the process, so the machine hall is kept at a constant relative humidity of 42% and a temperature of 74°F. Air is completely changed every 5 min. and 90% is recirculated, plus 10% make-up of fresh air. The compressors deliver 55 tons of refrigerant. Scott and Scott Ltd., Salisbury, supplied the air conditioning plant and Sturtevant Engineering Co. Ltd., the *Precipitron* unit for cleaning the air.

There are 16 capsule-making machines which are kept going 24 hr. a day 5½ days a week. The automatic units which cast and finish the capsules were imported from America. The drying kilns, of British manufacture, were added when the machines were installed.

The production routine consists of making up the gelatin solution, casting and cutting the capsules, visual sorting of every capsule, and packing of capsules in polythene-lined drums.

Gelatin specification

Leiner's bone gelatin is used at Basingstoke. Strict control is exercised over bloom or gel strength, viscosity, colour, *p*H, total ash, particle size, reducing agents and bacterial count.

Bloom strength is an indication of the strength of film which the gelatin will produce in a capsule. Gelatins obtained from the first extractions are blended in suitable proportions to give the specification figure.

The viscosity of gelatin plays a vital part in the control of the thickness of a cast film. In the formation of a capsule it is directly responsible for the degree of thickness of the capsule walls. *p*H is an extremely critical factor because it affects the stability of the bloom strength and viscosity. It is also important because many of the dyes used are polychromatic and thus tend to alter their hue at different *p*Hs.

The reducing agent most commonly found in the past was SO_2, which resulted from the addition of sulphites, but the newer synthetic preservatives have now largely replaced sulphites. However, a limit for SO_2 must be established to guard against the reduction of the standard dyes.

A reasonable degree of uniformity of particle size must be attained to ensure a uniform rate of solution. Excessive amounts of coarse grinds unduly extend the solution time, whilst fine particles tend to agglomerate into insoluble masses which prevent efficient wetting.

A limit (total ash) must be established for inorganic material, chiefly calcium phosphate from the bone gelatin, because of its effect in imparting a cloud or haze to the finished capsules.

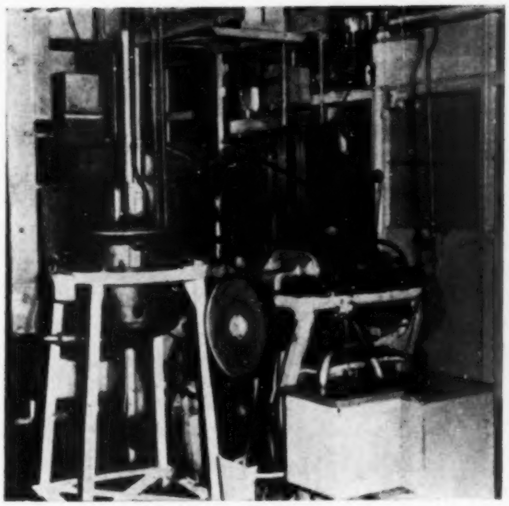
Gelatin becomes increasingly darker with successive extractions. Colour and clarity in a gelatin are of the utmost importance to ensure uniformity in shade from one lot to another.

The difficulties encountered with aqueous solutions, when the bacterial count is high, are liquefaction with subsequent loss of viscosity, and putrefaction. Gas-forming bacteria can cause trouble by liberating a large number of fine bubbles in the gelatin solution.

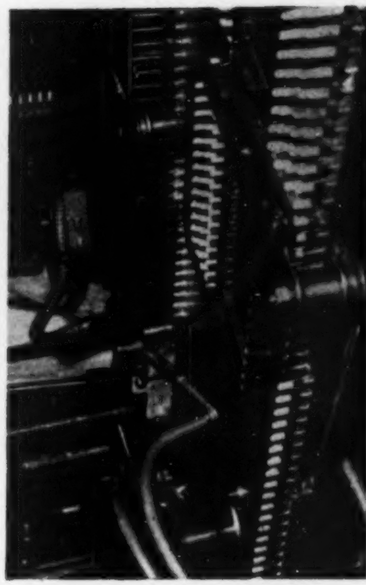
Preparation of jelly

Water for gelatin solution preparation is obtained from a Deminrolit demineralising plant of 160 gal./hr. capacity. Demineralising is essential because hard water salts can stain the pins of the capsule forming machines and produce a haze in the resulting capsules. CO_2 is removed from the demineralised water by aeration in a ceramic column. It is then heated in a calorifier and piped to the solution room. Here gelatin solution is made up at the rate of about 32 gal. per hr. and dye solution is added. The solution is poured into electrically heated, water-jacketed 8 gal. vessels mounted on wheels ready to be taken to the machine hall.

The viscosity is adjusted to suit the size of capsule being made. Larger capsules have thicker shells (0·007-0·0085 in. double wall thickness) than small ones (0·0065-0·0075 in.), so they require a more viscous jelly than the latter. It is



This view of a capsule machine shows the automatic stripping and polishing unit with the drying kiln behind. The 8 gal. pan to the left contains gelatin solution which has been prepared in an adjoining room. The pan has an electrically heated water jacket and is thermostatically controlled.



Capsule bodies and caps being stripped from the casting pins, trimmed and joined together. An unscrambling device assembles the casting bars in pairs, ready for another manufacturing cycle.

also necessary to take into account the fact that the longer jelly is left in the open dipping pan of the machine the longer it has to evaporate and become more viscous. Since large capsules use up jelly more quickly than small ones, it follows that the residue in the former case is less viscous than the latter and consequently requires a more viscous make-up jelly. Jelly is normally replenished in the machines every 5-7 min. Owing to the rapidity with which the gelatin in solution loses bloom strength, no time is lost between making and using the solution. From raw gelatin to finished capsule the process never takes longer than 12 hr.

Capsule making machines

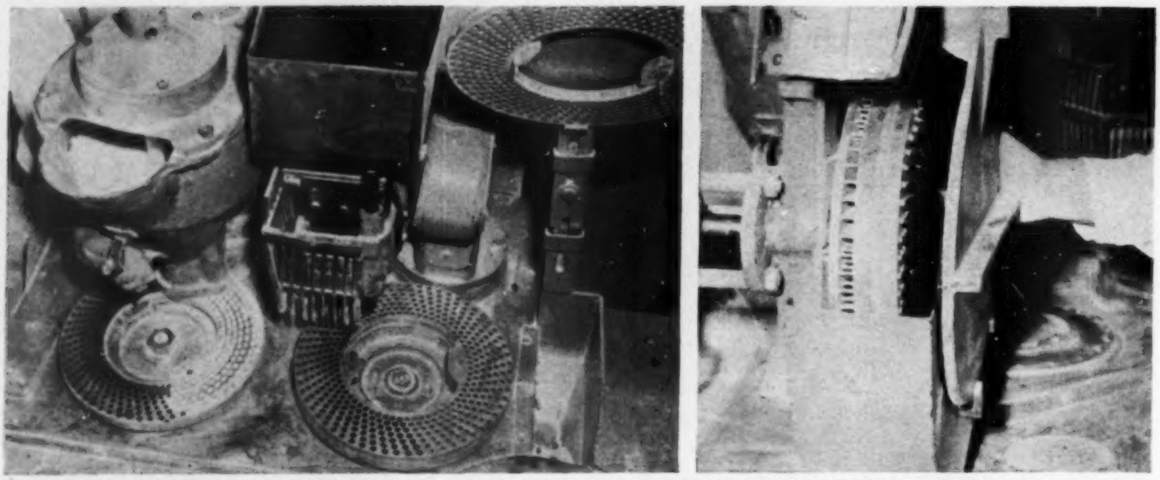
The machines consist of three units: Dipping pan unit, drying kiln and automatic finishing unit.

The capsule formers are stainless steel pins mounted on bars. Each bar has 30 pins and there are 175 pairs of bars for each machine, so that in one cycle a machine makes 5,250 capsules. One bar of a pair forms the cap and the other the body of the capsule.

The bars are automatically assembled and presented in pairs to the jelly. The pins are air-cooled so that the jelly instantly forms on them. After dipping, each bar is rotated in a current of air to ensure even distribution of the cast jelly over the pins, and then advanced to the drying kiln on a chain conveyor. They take 45 min. to pass through the kiln. Conditioned air is blown into the kiln, the lower part of which is kept at room temperature and the upper part at a few degrees higher. Precise control of drying is essential in order to eliminate problems caused by excessive or insufficient drying. An excessively dried capsule, for instance, would shatter very easily. Freshly made capsules contain a 3% excess of moisture, the final drying taking place in storage.

An unscrambling device removes the bars from the kiln and separates those containing caps from those containing bodies, assembling them in separate magazines before passing them to the mechanism which strips the capsules from the pins. The caps and bodies are stripped individually by bronze jaws which grasp the pins firmly and course the length of the pins, forcing off the gelatin film. Once released from the pins the caps and bodies are received in holes in two revolving discs where they are cut to size, fitted together and ejected as complete two-piece capsules down a chute into closed bins. Trimmings are removed by compressed air and collected in a separate bin. A proportion of

Some of the 16 capsule-making machines in the air conditioned machine hall.



THE CAPSULE FILLING MACHINE. Left: Capsules are being fed from the hopper into the pair of discs in the centre, the bottom disc receiving the body and the top the caps. After being separated from the top the lower disc is rotated beneath the powder hopper on the left, thus filling the capsules. Right: After filling, the disc containing the body of the capsule is paired with the one containing the caps and placed in a chuck which ejects the filled and joined capsules.

trimmings is used to make up fresh gelatin solution.

After stripping, the bars pass through a mechanism which polishes the pins and lubricates each one to make it ready for the next dipping cycle.

As already mentioned, an innovation at Basingstoke is the adaptation of the machines to the automatic production of capsules with bodies and caps of contrasting colours. The machines on which these are made have two dipping pans instead of one, the cap pins being immersed in one and the body pins in the other. As with the single colour capsules, the result is a capsule with perfectly matched cap and body.

When a machine is set up for making a certain size of capsule it is customary to keep it working on this size as long as possible. But to change the colour of the capsules being made is a simple adjustment which can be done in ½ hr.

Checking and sorting

Throughout manufacture the physical dimensions of capsules, such as double-wall thickness, length, and overall joined length are closely controlled with gauges. A tolerance of 0·0005 in. is rigidly observed for the double-wall thickness at the cut-off edge so that capsules can be handled efficiently in the power filling machines. A regular check is made also for colour match, blemishes or defective capsules to enable prompt corrections or adjustments to be made. Every check is entered at half-hourly intervals on a chart which provides a record of kiln temperature, capsule thickness, viscosity, water additions, blemishes and colour.

Every capsule is inspected visually by a team of 24 women who sort out capsules with faults such as air bubbles, specks, dents, loose caps or bad trimming. Clear capsules pass over an illuminated aperture and opaque ones under a lamp. A good inspector can sort between 10,000 and 12,000 capsules per hr. Using a vibrating table which passes the capsules at a steady rate in front of the inspector, up to 20,000 per hr. can be examined. The women and girls work an 8-hr. day with a break every 2 hr. This 100% inspection goes as far as is humanly possible to ensure perfect capsules. After sorting, the capsules are packed in polythene-lined drums for despatch either to Lilly's own filling machines or to outside customers. The drums used can accommodate 100,000 of the largest capsules and 360,000 of the smallest.

Capsule filling

Capsules are filled in the main factory. The filling machines are just as ingenious as the capsule-making units. They were made by the Lilly Company in Indianapolis, but it is understood that other types of machines are available from French, German and Italian manufacturers.

In the Lilly machine capsules are fed from a hopper through a tapered raceway in which the capsule is swivelled downwards, body first. In this position the capsules are sucked into holes drilled around the edge of a pair of aluminium alloy discs. There are 420 holes in rows of seven. Around the bottom of each hole in the top plate is a tiny lip. When the pair of discs is separated this lip engages the edge of the cap and draws it into the top disc, leaving the open body in the lower disc.

The lower disc is placed on a turntable and rotated beneath a powder hopper, filling each capsule by mechanical pressure. Every batch of powder is assayed and the filling machine is adjusted to give a constant dose of drug irrespective of the weight of powder.

The filled disc is paired with its twin and placed in a chuck against a disc fitted with pins which match the holes containing the capsules. The chuck is closed by compressed air and the filled and joined capsules are ejected into a chute which leads to a bin.

The vital operations are entirely automatic and one girl can deal with up to 55 pairs of discs per hour, depending on the size of capsule, thus filling a maximum of 23,100 capsules per hour.

Filled capsules are polished by hand. Girls wearing cotton gloves roll the capsules on a cloth stretched over a low-pressure air jet and adhering powder is quickly brushed off, leaving the capsules jewel-bright and ready for packing.

All operations involving scheduled poisons are performed in a security cage and all workers are screened for reliability.

Perfumes for Cosmetics

4. DEODORANTS AND ANTIPERSPIRANTS

By V. Vasic, CH.E.

Attempts to mask malodorous perspiration with perfume are often unsatisfactory, the result sometimes being a different but no less unpleasant odour. Here Mr. Vasic discusses the selection and compounding of perfumes for deodorants and antiperspirants and considers such aspects as irritation and discoloration. He gives formulæ for a deodorant stick and for appropriate perfumes. His previous three articles dealt with perfumes for face powders (July 1958), face creams (August) and lipsticks (October). Future articles will cover suntan preparations and bath preparations.

COSMETICS intended for the problem of malodorous perspiration are of two types: *deodorants*—which deodorise the perspiration without checking its flow to any appreciable extent, and *antiperspirants*—which reduce the amount of perspiration secreted. The presumptive effects of deodorants and antiperspirants are not sharply delineated and, in fact, products sold as antiperspirants are also deodorants, while some deodorants have an antiperspirant action.

Fresh perspiration may be relatively odourless and the characteristic and often unpleasant odour of perspiration is caused by the decomposition products that are soon formed by bacteria. This odour is due at least in part to the presence of lower molecular weight saturated fatty acids. Amino compounds are also said to be present.

Deodorants reduce the smell of perspiration by odour neutralisation, by absorption, or by destroying the odorous components. Antiseptic and germicidal compounds such as hexachlorophene (G-11), and quaternary ammonium compounds such as cetyl pyridinium chloride, cetyl trimethyl ammonium bromide, diisobutyl cresoxy (or phenoxy) ethoxy ethyl dimethyl benzyl ammonium chloride, etc., are often present in deodorant preparations to prevent decomposition and chemical changes in the original constituents of perspiration caused by bacterial action.

Antiperspirant preparations contain an ingredient which has an astringent action and inhibits the flow of perspiration. This type of substance is thought to react with skin protein, causing coagulation accompanied by a swelling at the openings of the sweat glands, blocking the openings and reducing the flow of sweat. The "active ingredients" of antiperspirant preparations at present most commonly used are salts of aluminium and zinc. Sulphate, chloride, chlorohydroxide and phenolsulphonate have been most widely used, although basic formate, lactate, sulphamate and the alums are also found in antiperspirant preparations.

Deodorants and antiperspirants may be put into four categories: liquid, cream, stick and powder, of which the first two are the most important.

Type of perfume

It is possible to use almost any type of perfume so long as the components are non-irritating to the skin. The perfumes must emphasise the impression of cultivated cleanliness and the odour should not be so heavy as to compete with other perfumes worn by users. The refreshing odours of rose, lavender, etc., or more subtle combinations of fancy bouquets, are most useful. Products intended for men only are also perfumed with citrus colognes and aldehydic colognes.

Perfume compounding

When compounding a perfume for a deodorant or antiperspirant, the perfumer must of course, be fully familar with the raw materials used in the product.

A perfume must be compatible with all components of the product and all perfume ingredients which would create some difficulty must be avoided.

The perfume materials to be used in antiperspirants must be stable under acid conditions. Antiperspirant creams and lotions can have a *p*H as low as 2 but never higher than 4·5.

Essential oils which contain large amounts of terpenes must be avoided because they will resinify after some time. Essential oils which contain a high proportion of esters, such as bergamot and lavender oils, should also be avoided. Linalyl acetate is destroyed to a more or less large extent after some time.

Occasionally a perfume will cause bleeding or separation in an otherwise stable antiperspirant cream. The perfume must be checked in the cream, even if it is compatible with the individual ingredients of the cream. The shelf life test must be carried out at room temperature and at a slightly elevated temperature (40° to 45°C.) for a reasonable period of time (three to six months) to observe any change in colour or odour which may take place.

In deodorant preparations the perfume often must cover not only the odour of basic fatty materials, but also the odour of the antiseptic which might be incorporated.

In compounding a perfume for deodorant preparations containing quaternary ammonium compounds it must be borne in mind that some of these materials may have a deleterious effect on a perfume composition.

Hexachlorophene does not affect the original olfactory note of a perfume. It tends to dampen the odour of the perfume materials by physical attraction between the molecules, with a resulting lowering of the vapour pressure which produces a fixative phenomenon.

Therefore hexachlorophene acts as a perfume fixative.

While the colour of most perfume materials is unaffected by hexachlorophene, some discolour a little. All the following materials discolour markedly in the presence of hexachlorophene: acetophenone, *alpha*-amyl cinnamic aldehyde, amyl benzoate, benzaldehyde, benzyl benzoate, bornyl acetate, cananga oil, citral, decyl aldehyde, heliotropine, isoeugenol, methyl acetophenone, *alpha* methyl ionone, methyl isoeugenol, palmarosa oil, patchouli oil, Singapore, peppermint oil, phenylacetaldehyde dimethyl acetal, phenyl methyl carbinyl acetate and ylang-ylang oil.

A perfume for a deodorant stick must contain only ingredients which are stable in a slightly alkaline medium. Perfume containing ingredients sensitive to alkali may be affected in various ways by the soap gel. On ageing of the stick the fresh top notes may disappear and the perfume may develop an unpleasant character. The colour of the stick may darken due to the action of alkalis on some perfume ingredients. The possible influence of the perfume on the properties of the alcohol gel should not be ignored, because certain perfumes may affect the stability of the gel, resulting in bleeding of the stick.

Polyethylene spray-type containers are widely used for packing liquid deodorants and antiperspirants Although polyethylene containers are inert to spray ingredients, they are somewhat permeable to many perfume ingredients. Wight, Tomlinson and Kirmeier listed common perfume materials in the order of their transmission rates through polyethylene. They found that the nature of the cosmetic vehicle plays a strong role in determining the rate of permeation. Alcoholic preparations lose less perfume than preparations in mineral oil or water. This may be due to a "blocking effect" by the vehicle or may be a partition of the perfume between the polyethylene and the solvent vehicle. It is therefore important to select such perfume ingredients in the compounding of a perfume which shows the least diffusion through the container.

Irritation

It is of very great importance that every component of a perfume intended for perfuming deodorants or antiperspirants (or products having both qualities) is free of irritating qualities, because these products are in long contact with the skin, especially with areas which are extremely sensitive. All known perfume irritants must be avoided, but other materials used in the preparation of deodorants and antiperspirants may also cause irritation and they must be fully tested before use.

Discoloration

Only perfume compounds which are known to be non-discolouring should be used. In spite of keeping this rule some of the antiseptic and germicidal products used in deodorants and antiperspirants may cause discolouration in the presence of certain perfumes, particularly when used in white creams. Extensive tests must be carried out before perfume ingredients are chosen.

Concentration of perfume

The concentration of perfume varies according to the type of product. For deodorant creams or emulsified lotions the recommended concentration is 0·5%. For aqueous alcoholic type deodorant products a concentration of 2·5% of perfume oil at cologne strength is recommended. The concentration of perfume in deodorant sticks is from 2 to 4%, usually 3%.

Incorporation of perfume

In aqueous alcoholic preparations perfume is incorporated by dissolving it in the alcohol used. A small amount of nonionic perfume solubiliser such as *Nonex* 39, *Nonex* 55 (Gemec Chemical Co.), *Texofor* A1P, *Texofor* D40 (Glovers (Chemicals) Ltd.), *Tween* 30, *Tween* 60, *Tween* 80, *Atlas* G-2162 and *Atlas* G-7596-P (Honeywill-Atlas Ltd.) will serve to disperse the perfume in the solution. Diethylene glycol monoethyl ether helps also in bringing perfumes into solution.

In cream and emulsion type preparations the perfume should not be added to the emulsion at a time the emulsion is very hot. The perfume is incorporated when the preparation has been completely emulsified and the temperature has been reduced to about 45°-50°C.

In the gel type preparations, such as antiperspirant gel, if the perfume oil is dissolved in the alcohol, a cloudy solution results when the alcohol is mixed with the astringent salt solution. To obtain a transparent product, the perfume should be incorporated in the astringent solution following addition of the alcohol.

In powder preparations the perfume should be well blended with a part of the talc and then incorporated into the batch.

The incorporation of perfume in a stick preparation is shown in the following formula:

Deodorant stick

Portion A	
Stearic acid	4·5
Alcohol	83·5
Propylene glycol	3·0
Hexachlorophene (G-11) ...	0·25
Perfume	3·0
Portion B	
Sodium hydroxide, pure ...	0·75
Water	5·0

Procedure

Weigh the ingredients of portion A into a container and heat to 72°C., while stirring. Warm the solution of portion B to about 45°C. When these temperatures are attained, add the portion B to portion A, stirring rapidly to assist the solution of the soap which is formed. The product should then be poured into moulds.

These two formulæ will produce perfumes which are stable and will not cause discoloration in deodorant-antiperspirant preparations.

Perfume A.P.11

for deodorant-antiperspirant creams (G-11 and aluminium salts)

Lilial, Givaudan	5
Irisone, pure	5
Citronellol	20
Phenylethyl alcohol	20
Geraniol	20
Rose Fania II, Givaudan	30
	100

Perfume A.P.12

for deodorant-antiperspirant lotions, aqueous-alcoholic type (G-11 and aluminium salts)

Alpha-Irisone	5
Rose soluble 1724, Givaudan ...	20
Phenylethyl alcohol	20
Citronellol	20
Geraniol	20
Diethylene glycol mono-ethyl ether, rectified	15
	100

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(Concluded on page 244)

Left: Bottles being filled with cologne in a corner of the vast new factory. Right: A battery of labelling machines at work on bottles of Satin-Flow make-up. Over 200 girls work in the 130,000 sq. ft. single floor building.

Cosmetics for the Masses

IN THEIR GOLDEN JUBILEE YEAR MAX FACTOR OPEN A NEW FACTORY

WHAT is probably the biggest cosmetics factory in Europe was officially opened on May 1 by Lord Rank, chairman of the Rank Film Organisation. In this case the link between films and cosmetics was particularly close, because the factory belongs to Max Factor Ltd., British branch of the American company which was founded just 50 years ago by the master of cinema make-up and which is now controlled by his son, Davis Factor, who came from Hollywood for the opening ceremony.

The factory is at Poole, near Bournemouth, on the site where the firm set up production in 1946 in a war-time radar factory, having moved there from their wartime location in Croydon. A full description of how the factory was converted to cosmetics production appeared in the February 1948 issue of MANUFACTURING CHEMIST (pp. 49-58). Then there were two factories adjoining each other. The new factory is a single floor building of no less than 130,000 sq. ft. all under one roof. It is the largest single building devoted to cosmetics manufacture one is likely to see anywhere. Production is what is to be expected—a million items a week, 50 million a year. And this has been accomplished mainly by hoisting productivity—literally every item is touched by human hand, the nimble fingers of 220 girls, so it is not possible to make remarkable gains in production by installing a few wonderful machines, assuming such machines exist.

Max Factor's problem is that in spite of mass production there are many short run orders—special shades and textures for special export markets, and so on. Often these orders have to be filled in a few weeks, before the buyer in Burma or Timbuctoo has his import licence withdrawn. The answer is simply that no machine can match the versatility of human beings. So some visitors may be disappointed at the apparent lack of automation in the factory. We are assured that every operation has been carefully costed and in many cases hands are more economical than machines.

The biggest plant is the mixer-pulveriser which handles the talc for Pan-Cake and Creme-Puff make-up. After the powder, pigments, perfume and cream are blended the mixture pours into a machine which compresses it into cakes which are pressed into godets and then dried naturally before being assembled into their smart containers. Eight such machines turn out make-up cakes, each one producing as many as 50 per minute.

Fifty-two shades of lipstick are produced. After being passed through triple-roll mills the mixture of waxes, oils, stain and colour is perfumed and transferred to the pouring tanks. Girls fill moulds with the lipstick mass, chill it in a refrigerator and then eject the sticks from the moulds, whence they go to the packing belt. Each lipstick is carefully examined and flamed to impart the desirable gloss. A new product now being made at Poole is white lipstick for applying under or over normal lipstick to get novel shade effects.

While lipstick and cake make-up and fluid make-up are the main products they are by no means the only ones. Eye-shadow, face cream, suntan cream, conditioning cream and all the other accessories of the dressing table are made. But one of the chief reasons for the recent expansion has been Max Factor's entry into fragrance and into men's toiletries. There is now Hypnotique perfume and toilet waters and for men the Busy Man's Bar, a trio comprising cologne, after-shave lotion and cream hair dressing. Then there is a shampoo and pressurised shaving cream. Because it employs a pressure pack, Lazy Shave is filled under contract by a firm of aerosol specialists, as indeed is Max Factor's pressure hair spray. Perfume manufacture requires the bulkiest items of plant in the factory—five 500 gal. stainless steel tanks for ageing colognes and perfumes.

Besides the new factory, the firm has built a block of offices on the same site. Total cost of the new buildings was some £300,000 and there is still room for expansion.

PERFUMER'S ODYSSEY

By Steffen Arctander

Vetivert in Réunion and the Belgian Congo

Continuing his series on essential oil producing centres, Mr. Arctander describes the cultivation of vetivert root and the distillation of the oil in Rèunion Island and in the Belgian Congo. He comments on production methods and quality variations in both areas.

VETIVERT root has been known since antiquity in India, where it was used as a perfume, a spice, medicine, a fibrous material for mats, etc. From Indonesia (Java) the plant, which is a grass, was transported to the island of Réunion during the nineteenth century, probably even earlier. The roots of vetivert, which are highly fragrant, serve also to preserve furs, woollens, etc., against the attacks of insects. The word " vetivert, " more correctly spelled " vetiver, " derives from the Tamil word " vettivern. " The Tamils are inhibitants of Ceylon and the South of India and the plant is found there, both cultivated and wild.

As is often the case with essential oils, the centre of production for vetivert oil has changed during the last decades. The production of vetivert oil in Réunion is about 30 or 35 tons a year, sometimes more. This compares well with the quantity produced in Java in the years before World War II. Java does not produce such quantities now, and it remains doubtful whether it will ever regain its position as a producer of importance.

It was the Arabs who first imported the vetivert root to Europe. In Réunion all vetivert is cultivated specifically for the distillation of the oil from the rootlets. Distillation is done on the spot, and vetivert oil is an important source of income for the island. With its 1,000 sq. miles, of which less than one-third are cultivable, Réunion is incapable of supporting large plantations of perfume plants and vetivert is grown on a multitude of gardens and small estates, mostly along the coastline.

Distillation

It has been postulated that vetivert oil distilled in Europe in modern stills by experts is qualitatively far superior to the oil distilled on the spot. It is true that these two oils are different, even if they derive from roots grown in the same place. It is also possible that the preparations of the roots for distillation are different in Europe from Réunion. Distillation itself runs quite differently. It is much faster in Europe than in Réunion, where often 30 to 40 hrs. at 4 or 5 atmospheres of vapour pressure are necessary to complete the distillation, while in modern apparatus yielding 10 to 12 atmospheres pressure, 12 to 16 hrs. are sufficient. Root material distilled on the spot can easily contain siftings, dust, etc., from the rootlets, which will not be found in bales for export. Thus small differences in root material arise.

Vetivert roots must be about two years old when they are harvested for distillation. This rule is observed in Réunion island as well as in the Belgian Congo.

In Saint-Pierre on the south-south-west coast of Réunion I discussed vetivert oil with Mr. Pichon de Bury, chemical engineer for the Barbot company, one of the big names in vetivert oil, geranium and vanilla in Réunion. When we arrived at the godown and the laboratories of the Barbot Co. we found Mr. de Bury very busy, although it was late evening. He was just about to control several lots of geranium oil which had arrived the same day. He showed me some interesting samples of vetivert oil, the so-called commercial qualities as well as special qualities. These were experimental and came from distillation experiments of various kinds. One sample showed an optical rotation of +48°. Other samples were productions from different sources, fractions from distillations, etc. All these experiments seemed to indicate that a prolonged distillation will often give an oil with powerful dextro rotation and high viscosity, but the age of the rootlets and the quality of the soil are also important.

Optical rotation

I asked Mr. de Bury if there was a connection between the optical rotation of vetivert oil and its quality as a perfume material. He confirmed that many clients still buy this oil according to its optical rotation, and that they most often demand a minimum of +18°. He thought that this physical constant was a reliable method of evaluating the oil for perfumery purposes.

Vetivert oil exports produce about 5% of the total income of the island and vetivert oil Bourbon has maintained its high standard for many years. Even a few defective shipments would ruin the reputation of this oil on the world market, and competitive producers in other countries would not hesitate to exploit such a situation. This is why I feel sure that all oil exported from Réunion is the pure and non-altered distillate of vetivert roots, although in various qualities, according to the wishes of the clients. Most oils produced in Réunion are of +19° to +22° optical rotation.

Odour notes

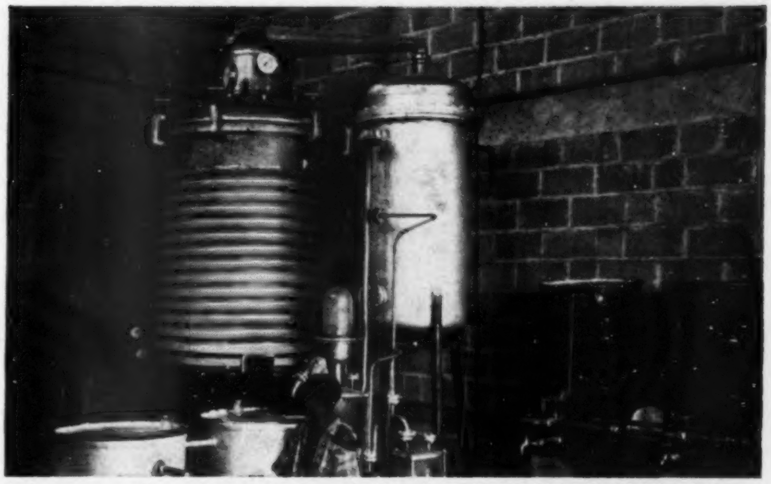
Among my samples of vetivert oil Bourbon I have a very light-coloured one distilled for a special order. It is very light yellowish oil with an optional rotation of +16·5° and distinctly less viscous than normal oils exported. Its fixative properties were slightly inferior, but properly aged it presents a beautiful, sweet body.

The light heads of fractions of a Réunion vetivert oil (not too aged) contain exactly the elements which are so often described as smelling like potatoes or other raw vegetables. These descriptions have been applied to too fresh vetivert oils or oils distilled from too young roots. I think the odour resembles asparagus. This, by the way, is exactly the aroma which forms the base of the flavouring essences for soft-water drinks which are popular

in India under the name of " Khus." " Khus " is an Urdu name for the grass which grows wild, and which is used for the distillation of vetivert oil from the rootlets, but which is mainly used for mat fibre.

The principal and desirable note of vetivert oil should be the sweet, soft, tenacious woody but *not dry* note. This is also found in the isolated sesquiterpenic alcohols commercially called " vetiverol " or " vetivenol. " This combination of alcohols and the vetivert oil itself is acetylated by certain manufacturers of perfumery materials, but the results are highly different. Not only are vetivert oils of different origin used in the acetylisation, but in some cases the oil is directly acetylated and rectified, for which reason the products are marketed indiscriminately as vetivert acetate or vetiveryl acetate. Only the acetylated product of the isolated sesquiterpenic alcohols yield vetiveryl acetate properly called. This product is free from green, grassy or asparagus notes, and presents a fresh, fruity smell combined with a characteristic woody, not dry, note typical of vetivert. This is one of the rare perfumes which is woody and *not dry*.

Distillation apparatus in Réunion is almost all primitive, I found only one modern still yielding a high vapour pressure. Thus, it is necessary to prolong the time of distillation, but nevertheless the yield of oil amounts to only 1%, while in modern apparatus the yield easily surpasses 2% in less than half the time.



This modern still at a factory in Goma is the only vetivert still in the Belgian Congo. It is owned and operated by M. Etienne Legast and it produces a good perfumery grade of vetivert oil from roots collected from areas as far as 100 miles away.

Belgian Congo oil

The entire production of Belgian Congo vetivert oil is distilled in one modern distillation plant at Goma where an experienced chemical engineer has at his disposal well-equipped laboratories. He buys the roots from Belgian settlers and missionary stations. The roots arrive clean to this factory and are coarsely ground in a grinding mill, soaked in water overnight and distilled with steam at about 12 atmospheres pressure. Distillation is stopped after 18 hrs., sometimes less. The yield of oil is about 2·4% on the weight of the root material. As mentioned earlier, the age of the roots is of decisive importance. Roots of less than two years of age give a small yield of a thin oil, and roots of more than two years of age will give a small yield of an oil which is dark and viscous. The high-pressure boiler can increase the yield of oil significantly; it distils the heavy and viscous sesquiterpenes.

The quality of Belgian Congo vetivert oil is comparable to or superior to the average commercial qualities. Thanks to the central distillery its quality is strictly uniform. It is only distilled in very small quantities. Production for 1957 was less than a ton, a figure which could easily be increased, as vetivert grass is abundant in these regions. The distillery is owned by Etienne Legast, a young Belgian chemist and perfumer, who established himself in the Belgian Congo during 1952. Within a surprisingly short time he constructed a beautiful factory for distillation of essential oils and the manufacture of perfumes for soaps and cosmetics, etc. Literally with his own hands, Legast constructed a distillation hall, a boiler room, a bottling hall for finished products, offices, laboratories, etc. The boiler itself and the large stills were sent from European factories constructed to designs of Mr. Legast. The factory is at Goma, at the northern end of Lake Kivu. At the southern end of Lake Kivu, in the large city of Bukavu, the official Belgian control laboratories are constantly occupied with analyses of agricultural products for export. The following requirements have been established for vetivert oil for export.

1. It must be free from water and contain less than 0·3 g. per litre of insoluble impurities.
2. It must be free from copper.
3. It should have physical constants within the following limits: specific gravity at 15°C., from 0·990 to 1·040; refractive index at 20°C., from 1·520 to 1·528; it should be soluble in 3 volumes of alcohol at 80% per volume.
4. It should have a saponification number from 14 to 45.

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A vetivert field in Réunion during harvesting. Rhizomes have been collected and root stems are split and replanted.

Boots' Scottish Factory is Ten Years Old

It was on April 6, 1949, that Boots opened their new factory at Airdrie, 10 miles from Glasgow. Originally planned as a packaging unit, the factory is now manufacturing on a large scale. For instance, all of Boots' aspirin tablets, halibut liver oil capsules and compound codeine tablets are made at Airdrie, which now produces some 70 different products, besides packaging them. Here is a brief history of Airdrie's first 10 years.

THE decision taken by Boots Pure Drug Co. over 10 years ago to build another factory far removed from its headquarters at Nottingham not only involved a very large investment but also a departure from previous policy which had established all their production facilities in and very close to Nottingham.

It was prompted by a shortage of labour at Nottingham, and, after consideration of the Development Areas of Great Britain, Scotland was chosen and the company purchased a 150-acre site at Airdrie, 10 miles east of Glasgow. Contracts amounting to £1,250,000 were placed with local firms for the erection of the factory building which covers 8 acres. In addition £100,000 was spent on providing rail facilities on the site.

Ten years ago, on April 6, Mr. Tom Johnston, a former Secretary of State for Scotland and present Chancellor of Aberdeen University, opened the new building and production quickly got under way.

Airdrie had never known a similar industry—the population depending largely for immediate employment on steel tube fabrication, light engineering, papermaking and textiles.

Employment provided by nearby mines has declined over the past years, and the prospect of more mines being closed in the vicinity promises little for the future.

An average of about 600 people (about 40% male) has been employed each year at this factory since it opened. The total payroll has poured several millions of currency into the area, and, to add further to the economic aid of the district, many contracts for glass, bottle caps, fibre-board and packaging materials are placed with Scottish concerns.

Whereas the average age of girls at present employed by Boots at Airdrie is 24 compared to 33 at Beeston, the Airdrie average is increasing gradually over the years,

An aerial view of the Airdrie factory. It covers 6 acres and stands on a 150-acre site.

showing clearly how employees remain with the firm. Competition for vacancies is very strong, with many applicants for every job offered. Such a demand allows the personnel department to be selective and choose the best types.

Yet, although the numbers employed has been fairly constant, productivity has not. This has increased considerably over the years with a marked efficiency matching the best plants at Nottingham or Beeston.

More products made at Airdrie

The pattern of productivity has also changed.

When the Airdrie factory was opened, the plant was visualised largely as a packeting unit working on bulk materials processed elsewhere. Some of these items were complex preparations manufactured at Nottingham, and others, such as olive oil or liquid paraffin, came direct from outside suppliers and required little more than to be subjected to analytical control before being packed for sale. Only about a dozen lines were actually manufactured at Airdrie in 1949, while the number of non-processed lines was about 70.

With the passage of time the picture has altered completely.

Manufacturing facilities have gradually been expanded over the years, and as the locally-recruited employees have gained in skill and experience the factory has been able to assume responsibility for the manufacture of approximately 70 lines which are packed there. Dependence on the parent unit is, therefore, much diminished.

Diversity of products ranges from the head (brilliantine) to the toe (corn solvent).

The entire production of the firm's aspirin tablets, halibut liver oil capsules, and compound codeine tablets is made at Airdrie. Aspirin tablets are produced at an average rate of about 20 million a week. During the Asian 'flu epidemic last year output rose in one week to 45 million.

Distribution from Airdrie is direct to those of the firm's branches north of a line which includes Cumberland, Westmorland and Northumberland. This accounts for about one-eighth of the total Airdrie production. The remainder goes to Beeston by regular rail and road services for distribution to other branches.

Exports from Airdrie are established as an important part of the organisation.

In all, 20 countries abroad import Airdrie goods, although many products are sent to a "general" area which includes more countries.

Among these exports, gripe mixture goes to Uruguay, China, Indonesia, Thailand, Persia and Pakistan. Aspirin tablets are dispatched to Belgium, Cambodia, Kenya and the Far East. Halibut liver oil capsules are sent to South Africa, Turkey and the Far East. *Meloids* earn Canadian dollars, and *Fulset* is exported in bulk to Dutch tomato growers.

Such expansion has firmly established the Airdrie factory.

"We could not do without it now. It has become an integral part of the Boots organisation," says Mr. J. Greenwood, assistant production manager (pharmaceutical) and the first manager at the Airdrie factory.

Before he spent nine years in charge at Airdrie Mr. Greenwood took an active part in the factory design to ensure that increased productivity which has been achieved.

He says he has had one other great help—enthusiastic co-operation of the Scots workers from floor level to departmental managers.

The present manager, Mr. S. A. Hibbert, confirms this view.

An explanation for this enthusiasm may be the policy adopted by the company since 1949 of rewarding ability among local workers. A surprising number of departmental heads at Airdrie today joined the firm ten years ago as labourers.

Mr. C. Boyle, 37-year-old manager of the Bulk Stock Department, began there in 1949 as a labourer and says of the factory: "A lot of other firms have come to and gone from Airdrie during the past few years, but we know Boots will stay. They offer security, and that means a lot in a district which has not really known it before."

Layout

Another factor which is in part responsible for the factory's success is the layout of the plant itself with a design specially made to meet Boots' demands. Tailor-made for the job, and using work study and efficiency methods as a guide, it follows a simple pattern.

The entire frontage of the building is used for office space, with the canteen and rest rooms above.

Filling and packaging liquid pharmaceuticals at the Airdrie factory. Six fifteen-head Albro filling machines are used in the "wet" filling department.

Behind, the general flow of production is from north to south. About one-third of the factory space is devoted to the receiving and storage of raw materials and packaging materials; the central third to production; and the remainder to warehousing and despatch.

It is a two-storey building, allowing gravity filling for both the "wets" and "drys" sections, each of which is completely separate.

The factory floor has a headroom of 17 ft. 6 in., allowing room for the electrically powered forked trucks which service all departments.

A photo-electric cell device 10 ft. from the dividing doors is placed so that the driver's head breaks the ray, causing the door to open. Sufficient time is allowed for the vehicle to pass before the door closes automatically.

Water used for processing is passed through a *Deminrolit* plant to provide de-ionised water.

Machinery

Almost all the machinery in use at Airdrie is automatic, in keeping with a unit designed to produce very large quantities at short notice, and with as little change in general production lines as possible. A battery of automatic weighing machines is used for packaging "drys," with a series of vibratory machines used for weighing lozenges.

In the "wets" department six fifteen-head *Albro* filling machines are installed together with a variety of other filling machines of a semi-automatic nature. The majority of equipment used for filtering, mixing, emulsifying, and stirring in the "wets" is British.

Manufacture of aspirin and codeine tablets is carried out by 12 Manesty rotary compressing units in a department operated from 6 a.m. to 10 p.m. on a shift basis.

Electronic and automatic box machines are used for tablet and capsule counting. Cotton-wool insertion and capping is carried out by Consolidated machines, after which the filled bottles are labelled automatically further along the flow line.

Seven bottle-washing machines are installed. One of these is a caustic washing unit by Dawson, and the remainder for rinsing are provided equally by Dawson and Powley.

The factory is equipped with its own standards laboratory under the charge of Mr. J. W. Murfin, B.SC., F.R.I.C., divisional analyst. Here all incoming raw materials are checked as well as samples from every batch produced at the plant. Mr. Murfin, who has a staff of 25, is also responsible for the accuracy of labels.

A fleet of diesel lorries is used to deliver finished goods to the branches. Rail services on the site, where the company has its own diesel locomotive, are used to despatch some of the finished products to Nottingham.

In line with the increased turnover bulk handling of liquids has displaced handling drums over the years at Airdrie. Tankers containing such items as liquid paraffin, cod liver oil, and ammonia pull in alongside the factory's northern edge and pump their cargoes direct into large storage tanks.

A staff of men and women, equipped with electric polishers and cleaners, is responsible for the very high level of cleanliness throughout the factory.

An Industrial Health Unit is under the kindly Highland care of Sister Macrae, with a doctor attending twice a week.

The social and athletic club's wide range of interests also contributes to the atmosphere of a factory not known before at Airdrie, and, following company policy, wage rates paid there are equivalent to those at Beeston, where it is more difficult to find labour.

An impartial opinion of the Boots plant was provided recently when sixth year pupils of Airdrie Academy undertook a survey.

Called "A Town to Live In," it was carried out by the senior pupils to discern whether modern trends in local housing, factories, churches, and schools were agreeable to the general public.

Question 8 asked: "Which of the new factories do you prefer and why?"

Boots' factory won about 70% of the votes, with no other single factory having more than 8%. Editorial comment pointed out that "People were struck by the spaciousness, cleanliness, and provisions made for light. Everyone felt that the workers had conditions in which it would be a pleasure to work."

Their former Provost, Councillor D. Bonner, who was the town's first citizen at the time of the official opening in 1949, agrees.

In his seventies, Councillor Bonner, leader of the socialist group there, remembers the days in the early thirties when half the population of Airdrie were unable to get work.

"When we first heard that Boots were looking for a factory site somewhere in Scotland we were determined to attract them to Airdrie. The site they have now was originally scheduled for 1,000 houses, but we got the factory and built the houses elsewhere.

DEODORANTS AND ANTIPERSPIRANTS

(Continued from page 238)

D. Burton, Deodorisation of the human body, *Alchimist*, 1952, **6**, 179; 206.

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E. G. Klarmann, Chemical and bacteriological aspects of antiperspirants, *J. Soc. Cos. Chem.*, 1956, **7**, 85.

E. Sagarin, Editor, "Cosmetics, Science and Technology." New York: Interscience, 1957.

V. Vasic, The effect of hexachlorophene on 92 perfumery materials, MANUFACTURING CHEMIST, 1955, **26**, 458.

F. O. Walter Meyer, The *p*H value in antiperspirants, *Pharmazie*, 1953, **8**, 240.

C. F. Wight, J. A. Tomlinson and S. Kirmeier, Difficulties encountered in the use of polyethylene as packaging material, *Proc. Sci. Sec.* T.G.A., 1953, **19**, 30.

PERFUMER'S ODYSSEY

(Continued from page 241)

5. Congo vetivert oil quality 1 should have an optical rotation at 20°C., of not less than +20°; acetylation number minimum 130. Congo vetivert oil quality 2 should have an optical rotation at 20°C. from +15° to +20°; acetylation number 110 to 130. As far as solubility is concerned, the Congo vetivert oil is generally, according to my experiences, more soluble than all other vetivert oils, except the very best qualities from Réunion.

Vetivert resinoid

Some readers will know a product called "Resinoid of Vetivert," which should be an extraction product of vetivert roots. I have met several so-called "resinoids of vetivert," but often they are only residues from the rectification of vetivert oil or tail fractions from the isolation of the oil, Congo vetivert resinoid is absolutely pure and comes from an extraction of vetivert roots. Following the total extraction, the solvent is removed in vacuum. The resinoid obtained is a brown, highly viscous mass. It is often desirable to obtain a vetivert effect in soaps or low-priced perfumes, and in these cases vetivert resinoid presents a nice solution. Moreover the fixative qualities of the resinoid are even more pronounced than those of the oil, because its price is only little more than half the price of the oil.

Correspondence

TO: THE EDITOR.

John Bell

SIR: I have read with interest your article concerning Jacob Bell under "Topics and Comments" in the current number of MANUFACTURING CHEMIST, p. 187.

In 1836, when Jacob Bell was taken into partnership by his father, the business in Oxford Street was known as John Bell and Company and was so known until 1908. On July 22, 1908, 49 years after the death of Jacob Bell, the business of John Bell and Company, at 225 Oxford Street, and the business of Croyden and Co. Ltd., of 55 Wigmore Street, were acquired and incorporated as John Bell and Croyden Ltd.

Subsequently, on January 2, 1909, the wholesale and manufacturing activities of the business were separated from the retail by the incorporation of John Bell, Hills and Lucas Ltd. as a separate company.

W. HYDE HILLS.
Managing Director
John Bell, Hills and Lucas Ltd.
London, S.E.26.

Dragoco Report. The most recent of these monthly reports published by Dragoco G.m.b.H. contains an article on higher fatty alcohols, higher aldehydes and acetals in modern perfumery.

American essential oils. This is the title of a 24 pp. booklet produced by Magnus, Maybee and Reynard Inc. which gives physical and chemical properties of some twenty American-produced essential oils.

Surface active agents. A new edition of a booklet on *Nonex* non-ionic surface active agents has been published by Union Carbide Ltd. It describes the general principles of non-ionic surface activity and the general properties and uses of non-ionic surface active agents manufactured by the company. Uses are grouped under various industries and typical formulations are given.

Reagents and solvents. Two booklets from Hopkin and Williams Ltd. deal with the company's P.V.S. reagents and *Spectrosol* solvents for absorption spectroscopy respectively. The reagents, which are intended for the most highly critical work, are potassium dichromate, potassium iodate, sodium chloride, potassium bicarbonate and benzoic acid.

The solvents described are both polar and non-polar and of high ultraviolet transparency.

Glycols and Polyglycols

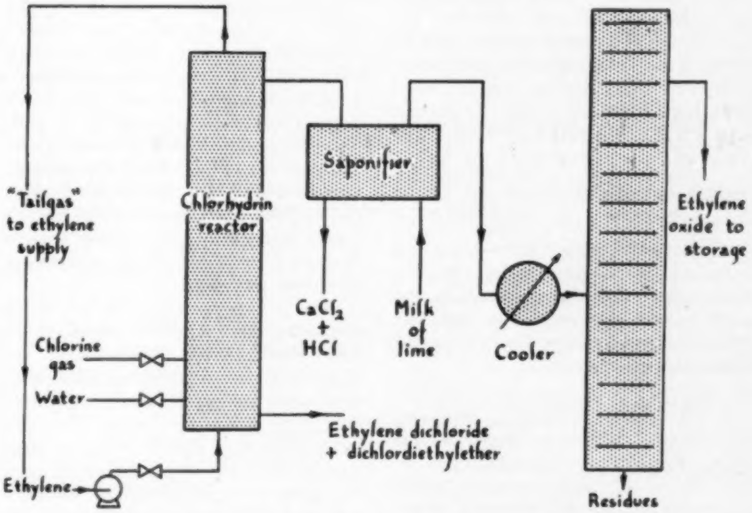
By Leon Raphael, M.SC., F.R.I.C.

I. CHEMISTRY AND MANUFACTURE

While the major use for ethylene glycol continues to be automotive antifreezes, glycols and polyglycols are being used increasingly in humectants, air sterilisers, brake fluids, cosmetics and pharmaceuticals. In 40 years the manufacture of glycols has multiplied enormously. Production in the U.S. is over 500,000 tons p.a. and in Britain it is likely that output will reach 60,000 tons within a few years. With this article we commence a three-part survey of the chemistry, manufacture, properties and applications of these important chemicals.

EXACTLY 100 years ago, Charles Adolphe Wurtz, a French chemist, carried out the first synthesis of ethylene glycol. For nearly 60 years afterwards it remained a laboratory curiosity, and it was not until 1925 that ethylene glycol was manufactured on a commercial scale. Since the second World War the developments in the petroleum chemicals industry have offered a ready source of ethylene and propylene, resulting in a rapid expansion in the manufacture of glycols to meet the growing demands of several industries. The principal use of glycols is for "anti-freeze" in car radiators, but they also find application as humectants for tobacco, as intermediates for alkyd resins and polyester fibres such as *Terylene*, and as solvents in the manufacture of foods and pharmaceuticals.

During the first World War the Germans made ethylene glycol on a relatively small scale. The glycol was nitrated to supplement supplies of nitroglycerin. After the war the Americans investigated the manufacture of ethylene glycol, and in 1925 the first commercial plant went on stream at South Charleston, West Virginia. It was erected and operated by Carbide and Carbon, who remained the sole producer of glycols in the American continent for the next decade. Propylene glycol has been made commercially since 1931. After the second World War glycol production increased rapidly, and many other large companies entered the market; Dow, Du Pont, Jefferson and Wyandotte are just a few of the well-known manufacturers in the States and Canada. At present U.S. production of glycols is over half a million tons per annum.



Flow sheet of the chlorhydrin process of ethylene oxide manufacture.

The Germans, too, increased their interest in glycol production, and by 1945 it was estimated that their output was 40,000 tons a year. Japan and Belgium were also among the glycol producing countries by the late thirties. Britain is a new entrant to the field of petroleum chemicals, but is now in the lead in this industry in Europe. Our current production of glycols is probably about 25,000 to 30,000 tons a year, but this figure is likely to be doubled in the near future.

Since the early work of Wurtz, several laboratory methods have been described for the production of glycols, but only those of commercial importance will be described. In the United States about 90% of ethylene glycol is made from ethylene oxide, which is the only process operating in this country. An alternative process, operated by Du Pont, starts with formaldehyde which is treated with methanol and carbon monoxide at high temperature and pressure to produce methyl glycollate, which is hydrogenated to ethylene glycol over a copper-magnesium catalyst at 300°C and 400 atmospheres pressure. Formaldehyde is made from methanol, so that carbon monoxide and methanol are the two starting materials.

$$CH_3OH \longrightarrow HCHO + H_2$$
$$HCHO + CO + CH_3OH \longrightarrow HO.CH_2COOCH_3$$
$$HO.CH_2.COOCH_3 + 2H_2 \longrightarrow HOCH_2CH_2OH + CH_3OH$$

The glycol can be recovered in good yield by continuously distilling off the methanol, which is re-used in the process. Unreacted ester must also be removed rapidly, as a condensation reaction can occur with the glycol.

With increasing supplies of ethylene and propylene from the cracking of petroleum fractions, the more important method of glycol manufacture is from alkylene oxides. Although the chief outlet for these oxides is for conversion to glycols, they are themselves important chemicals used as fumigants and for the manufacture of glycol ethers (cellosolves and carbitols), ethanolamines and non-ionic detergents.

Ethylene oxide is made by one of two processes: 1. via chlorhydrin; 2. by direct oxidation.

1. The Chlorhydrin process

Ethylene and chlorine water, which may be considered as hypochlorous acid for the reaction, are fed into a reactor at about 30° to 50°C. at atmospheric pressure. Ethylene chlorhydrin is formed together with ethylene dichloride and 2·2′ dichlorodiethyl ether. The yield of chlorhydrin is about 85%.

$$\underset{\text{ethylene}}{CH_2{:}CH_2} + HOCl \longrightarrow \underset{\text{chlorhydrin}}{HOCH_2CH_2Cl}$$

Different theories have been put forward to suggest other mechanisms, but the above equation will suffice to illustrate the process. The by-products are formed by the following reactions:

$$CH_2{:}CH_2 + Cl_2 \longrightarrow \underset{\text{ethylene dichloride (1.1-dichloroethane)}}{Cl.CH_2.CH_2Cl}$$

$$Cl.CH_2.CH_2.Cl + HO.CH_2CH_2.Cl \longrightarrow \underset{\text{2.2' dichlorodiethyl ether}}{Cl.CH_2CH_2OCH_2CH_2Cl} + HCl$$

Dichlorodiethyl ether is used for the synthesis of morpholine derivatives and ethylene dichloride is a solvent used in the petroleum industry.

The chlorhydrin is converted to ethylene oxide by treatment with alkali or milk or lime.

$$HO.CH_2.CH_2Cl + \tfrac{1}{2}Ca(OH)_2 \longrightarrow \underset{\text{ethylene oxide}}{\underset{\diagdown\, O\, \diagup}{CH_2\text{—}CH_2}} + \tfrac{1}{2}CaCl_2 + H_2O$$

Ethylene oxide is isomeric with aldehyde CH_3CHO and a small amount of aldehyde is formed during this process. By distillation on a plate column, a high purity of ethylene oxide can be reached with aldehyde content less than 0·1%. The presence of a higher concentration of aldehyde may result in the formation of polymers which would affect the colour and odour of the glycol subsequently produced.

2. Direct oxidation

This process was introduced by Carbide and Carbon just before World War II and now more than half the ethylene oxide plants in America use this process. Shell have introduced a direct oxidation process to their plant at Partington, Manchester. The Carbide process was invented by Scientific Design Co. of New York and uses air as the oxidising agent. The Shell process invented by their American associates uses oxygen.

Air or oxygen is cycled with ethylene over a silver catalyst at 150°-400°C. at atmospheric or slightly reduced pressure. As ethylene and its oxide form explosive mixtures with air when its concentration is above 3%, a large excess of air or oxygen must be used to keep the ethylene oxide concentration below this limit in the outlet gas. Carbon dioxide is formed as a by-product.

$$2C_2H_4 + O_2 \longrightarrow 2C_2H_4O$$
$$2C_2H_4 + 6O_2 \longrightarrow 4CO_2 + 4H_2O$$

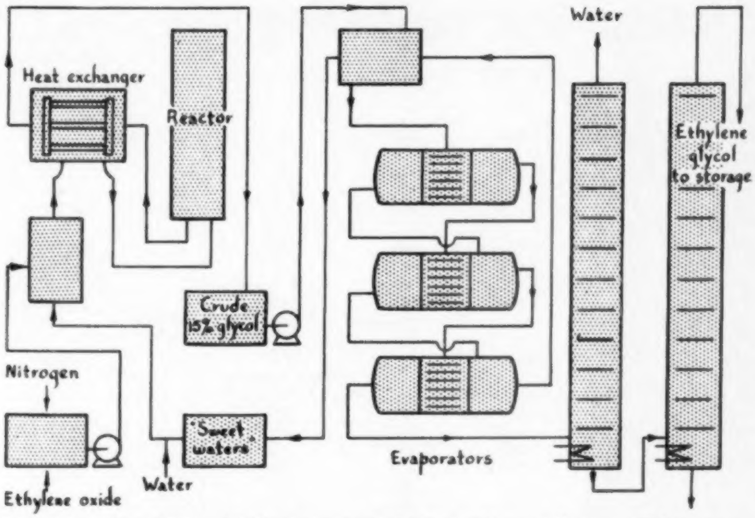
The second reaction is favoured by a higher temperature, and in order to control the formation of carbon dioxide a heat transfer medium such as *Dowtherm* or kerosene is circulated around the reactor. The conversion of ethylene to ethylene oxide is about 50-60% and the unreacted gas is recycled. When air is used as the oxidant, nitrogen must be purged from the unreacted gas and a separate purge plant is therefore required. The ethylene oxide is removed from the outlet gases by absorption in water under pressure from which it is distilled. The choice between air and oxygen as the more economical process appears to depend on the prevailing conditions at each particular plant.[1] The former requires a nitrogen purge plant and the latter requires an oxygen plant. Comparing direct oxidation with the chlorhydrin process, it should be noted that the latter process uses 0·9 ton of ethylene for every ton of ethylene oxide produced, while the direct process uses 1·1 tons of ethylene for the same production. On the other hand, the chlorhydrin process uses chlorine and there is the disposal problem of chlorinated by-products as well as the calcium chloride. The purity of the ethylene oxide by the direct process should be higher and will be completely free of chlorides. The absence of chlorides in glycol is important when it is used in the manufacture of electrolytic condensers (see later). The initial outlay on a direct oxidation plant is very much greater than on the chlorhydrin process, but in the long run proves more economical.

Hydration of ethylene oxide

Ethylene oxide is converted to glycol by hydrolysis. This is performed either at atmospheric pressure in the presence of an acid

Table I. Physical Properties of Glycols
(with Glycerol and Methanol for comparison)

	Molecular weight	*Boiling-point (°C.)*	*Specific gravity 20/20°C.*	*Flash-point (°F.) (Open Cup)*	*Freezing-point (°C.)*	*Refractive index* n_D^{20}	*Vapour pressure mm. (20°C.)*	*Viscosity cp. (20°C.)*
Ethylene glycol	62	197·6	1·1155	240	−13	1·4316	0·06	20·9
Diethylene glycol	106	245	1·1184	290	−8	1·4472	<0·01	35·7
Triethylene glycol	150	287	1·254	330	−7·2	1·4559	<0·01	47·8
Tetraethylene glycol ...	194	328	1·1248	350	−3·9		<0·01	60
Propylene glycol	76	187·4	1·038	225		1·4326		56
Dipropylene glycol ...	134	232	1·025	280		1·444	<0·01	107
Hexylene glycol	118	197	0·9234	214	sets to glass below −50	1·4276	0·05	34·4
2.Et. 1.3 hexanediol ...	146	244	0·9422	265	sets to glass below −40	1·4511	<0·01	323
1.3 butanediol	90	207	1·006	250	— −50	1·4401	0·06	89 (35°C.)
2.3 butanediol	90	182	1·0093	185	19	1·4377	0·17	121 (25°C.)
1.4 butanediol	90	230	1·020		16			
Glycerol	92	290	1·260 (25°C.)	177	17·9	1·4737	<0·01	939
Methanol	32	64·6	0·791	60 (closed cup)	−97·8	1·3307	96	0·59
Thiodiglycol	122	282	1·1847	320	−10	1·5217		



Flow sheet of the direct oxidation process of ethylene oxide manufacture. This process was introduced just before the last war.

catalyst or at high pressure with no catalyst. In the catalytic process about 0·5% of sulphuric or oxalic acid is dissolved in water and ethylene oxide is fed into the solution and heated to about 70°C. for ½ hr. Lime is then added to precipitate calcium sulphate or oxalate and the solution is filtered on a filter press. The filtrate, which is neutralised to *p*H 7, contains about 15% of glycols. In addition to the monoethylene glycol, the principal product, diethylene and triethylene glycol are produced. The ratio of ethylene oxide to water is adjusted to give the highest possible proportion of the required glycol. The greatest demand is for monoethylene glycol and this generally forms 80-90% of the reaction products. The operating conditions used in the pressure (non-catalytic) process were described in B.I.O.S. reports on the wartime German plants.[2] A ratio of 1 part ethylene oxide to 7 parts of water was subjected to 22 atmospheres pressure and 200°C. The contact-time was about ½ hr., but the process was arranged to cycle continuously, the glycol solution being removed. From either process the dilute solution of glycols is concentrated to 60% on a triple-stage evaporator, the vacuum being increased in three stages. The "sweet-waters" evaporated contain about 5% of glycols, and to avoid losses are used for further glycol production as process water. The concentrated glycol solution is then distilled under vacuum to remove water. The "bottoms" are distilled in a second column to produce monoethylene glycol, the "bottoms" from which are distilled to give di-, tri- and tetra-glycols as required.

$$\underset{\diagdown O \diagup}{CH_2{-}CH_2} + H_2O \longrightarrow \underset{\text{mono-ethylene glycol}}{HOCH_2.CH_2OH}$$

$$2\ \underset{\diagdown O \diagup}{CH_2{-}CH_2} + H_2O \longrightarrow \underset{\text{di-ethylene glycol}}{HO.CH_2.CH_2.O.CH_2CH_2OH}$$

$$3\ \underset{\diagdown O \diagup}{CH_2{-}CH_2} + H_2O \longrightarrow \underset{\text{tri-ethylene glycol}}{HO.CH_2.CH_2O.CH_2CH_2.O.CH_2CH_2OH}$$

$$4\ \underset{\diagdown O \diagup}{CH_2{-}CH_2} + H_2O \longrightarrow \underset{\text{tetra-ethylene glycol}}{HO.(CH_2CH_2O)_4H}$$

Propylene oxide

Propylene oxide can only be made by the chlorhydrin process. So far, no direct oxidation process has been successful in making propylene oxide, as other products are preferentially formed. The process for making the oxide is exactly analogous to that used for ethylene oxide by the chlorhydrin route and its hydrolysis to the glycols may be carried out by either of the methods described for ethylene glycol. Monopropylene glycol and di-propylene glycol are produced commercially.

$$CH_3.\underset{\diagdown O \diagup}{CH{-}CH_2} + H_2O \longrightarrow \underset{\text{propylene glycol}}{CH_3CH(OH).CH_2OH}$$

$$2CH_3{-}\underset{\diagdown O \diagup}{CH{-}CH_2} + H_2O \longrightarrow \underset{\text{dipropylene glycol}}{CH_3CH(OH).CH_2.O.CH_2CH(OH)CH_3}$$

Propylene glycol contains an asymmetric carbon atom and can therefore exist in two optical isomeric forms. These enantiomers have been prepared by biological or asymmetric syntheses and their respective optical rotations are $+13{\cdot}7°$ and $-9{\cdot}8°$.[3]

A stereoisomer of propylene glycol is 1·3 propanediol (trimethylene glycol) $CH_2(OH).CH_2.CH_2.OH$ and is recovered from glycerol, produced during the saponification of fats. It is, however, of little importance.

Dipropylene glycol

Dipropylene glycol exists in three stereoisomeric forms:

$HO.CH_2CH.(CH_3).O(CH_3)CH.CH_2OH$ —diprimary alcohol

$HO.CH_2CH(CH_3).O.CH_2CH(CH_3)OH$ —primary-secondary alcohol II

$HO.(CH_3)CH.CH_2.O.CH_2.CH(CH_3)OH$ —di-secondary alcohol III

Although the proportions of these three isomers present in the commercial product have not been reported, it is known that acidic hydrolysis of propylene oxide favours the formation of the di-primary alcohol, while alkaline hydrolysis favours the formation of the di-secondary alcohol.[4] The three isomers have been prepared and III differs from the others in being solid at room temperature, (m.p. 45°C.)[5]. The dipropylene glycol separated from the products of acid hydrolysis has a viscosity of about 50 c.p. at 20°C., while that produced by pressure hydrolysis has a viscosity of over 100 c.p. A high concentration of III would probably increase the viscosity of the mixture of isomers and would be expected from the pressure process. The acid process would therefore contain a high proportion of I and little of III. In the formulation of printing inks (see later) the viscosity of the dipropylene glycol used is an important property.

Recent investigations on the hydrolysis of ethylene oxide have suggested the possibility of using an ion-exchange resin to provide hydrogen ions as the catalyst.[6] This would eliminate the necessity of precipitating and filtering lime salts without incurring the expense of pressure vessels. The cost of the ion-

Table 2. Properties of Commercial Polyglycols

Designation	Average molecular weight	Freezing-point (°C.)	S.G. 20/20	Flash-point (°F.) (Open Cup)	Viscosity 210°F. c.s.	Refractive index n_D^{20}	Comparative hygroscopicity (glycerin=100)
Polyethylene glycols:							
1. Liquid at room temperature:							
200	190-210	sets to glass below −15°C.	1·128	340	4·2	1·459	90
300	285-315	−12	1·129	420	5·7	1·464	70
400	380-420	7	1·129	495	7·2	1·466	60
600	570-630	18	1·126	490	10·4	1·468	50
2. Solid at room temperature:							
800	760-840	29	1·131	485	13·7		5
1,000	950-1,050	36	1·140	475	17·3		5
1,540	1,430-1,570	45	1·150	480	27·2		5
4,000	3,300-3,600	51	1·204	520	75-78		—
6,000	6,000-7,500	55		515	700-900		—
Carbowax 1,500 (mixture of 1,540+300)	500-600	38	1·140	460	14·5		30
Polypropylene glycols:					*Saybolt Viscosity at 210°F. (secs.)*		
150	140-160		1·02	320	—		
425	350-450	−60	1·0103	385	4·2		
750	700-800		1·004	440	7·62		
1,025	900-1,050	−50	1·0072	455	10·94		
1,200	1,100-1,300		1·003	440	12·7		
2,025	1,900-2,100	−45	1·0055	440	23·9		

exchange resin and its regeneration would need to be compared with the outlay on the other processes. At present the pressure process is favoured, since it is easier to control the ratio of oxide to water and so increase the yield of monoglycol. It also ensures absence of calcium, sulphate or oxalate ions in the product.

Higher glycols

Higher glycols containing four or more carbon atoms have been prepared, but their demand, at present, is small. As the number of carbon atoms increases, so do the number of isomers. Some of these higher glycols were used in Germany for the production of butadiene and polyurethene foam plastics which will be discussed later.

The best known of these glycols is *hexylene glycol* (2-methyl 2·4 pentane diol). It is prepared by hydrogenation of diacetone alcohol and is used as a blending agent in hydraulic fluids and as a solvent for printing inks. Its isomer *2-methyl 1·3 pentane diol* is prepared by reduction of propionaldol and is available commercially in the States. **2.ethyl 1.3. hexane diol** is produced by hydrogenation of butyl aldol and is considered to be an excellent insect repellant. It is also used as a plasticiser for nylon moulding powders and for production of alkyd resins.

Butylene oxide is now being made in the States, although the butane diols have been known for some time and exist in three isomeric forms.

1.3 diol $HO.CH_2CH_2CH(OH)CH_3$ is prepared by reduction of acetaldol.

1.4 diol $HO.CH_2CH_2CH_2.CH_2OH$ by hydrogenation of 2-butyne diol.

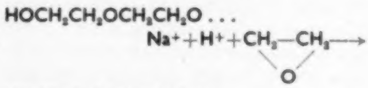
2.3 diol $CH_3CH(OH).CH(OH).CH_3$ is produced during the fermentation of sugars, molasses or corn starch, together with ethyl alcohol, glycerol and lactic acid, from which it can be recovered by distillation. This last diol exists in optically active forms and a mesomeric form.

2-butene 1.4 diol $HO.CH_2.CH{=}CH.CH_2OH$ is prepared by hydrolysis of 1·4 dichloro-2-butene and exists in cis- and trans-forms.

2-butyne 1.4 diol $HO.CH_2.C{\equiv}C.CH_2OH$ is prepared by reaction of acetylene and formaldehyde in the presence of copper acetylide. It is a crystalline solid melting at 64°C.

2.3 dimethyl 2.3. butane diol (pinacol), $(CH_3)_2\overset{\overset{CH_3}{|}}{C}(OH).\overset{\overset{CH_3}{|}}{C}.OH(CH_3)_2$ is prepared by hydrogenation of acetone in the presence of aluminium amalgam. During the first World War the Germans dehydrated pinacol to 2.3 dimethyl butadiene, which was polymerised to a synthetic rubber. As the product was unsatisfactory the process was discontinued.

Polyglycols. Just as the diglycols and triglycols are in effect condensation products of the monoglycols with alkylene oxide, so the polyglycols are higher condensation products. The usual process for their manufacture is to react ethylene oxide or propylene oxide with the corresponding diglycol under pressure in the presence of sodium or sodium hydroxide as a catalyst. The sodium ion forms a loose compound with the glycol which reacts more readily with oxide.



$HO.CH_2CH_2OCH_2CH_2O\ldots$
$Na^+\ldots{-}CH_2{-}CH_2{-}O\ldots H^+$

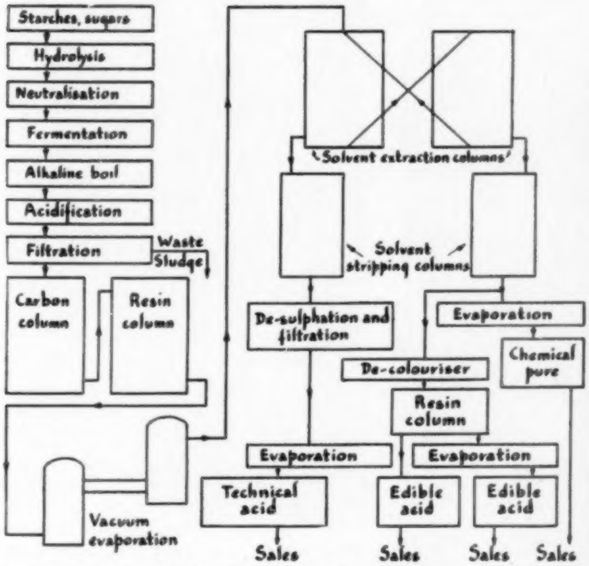
Under these conditions the ethylene oxide ring is easily broken and the hydrogen ion migrates to the position shown. The sodium ion moves out as the two molecules combine and then displaces the hydrogen again repeating the process.

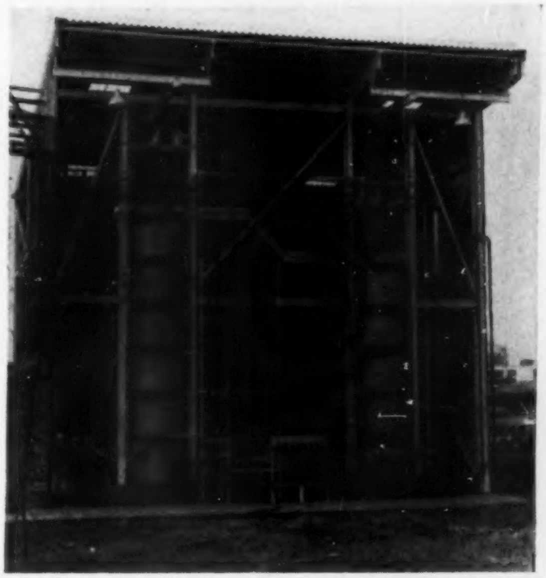
$HO.(CH_2CH_2O)_2{-}CH_2{-}CH_2O\ldots$
$Na^+ + H^+ + {-}CH_2{-}CH_2{-}O{-}$etc.

These polyglycols can be built up to any desired molecular weight, the oxide feed being stopped after the required calculated weight increase has been reached. In any product there will be polyglycols of different molecular weight represented statistically by a Poisson distribution.[7] The average molecular weight will correspond to that polymer present in the highest proportion. A wide or narrow distribution of polymers will depend on the conditions of the reaction. Mixed polyethylene-polypropylene glycols are also made, but these may differ in type. The *Pluronics* have been described previously in this journal[8] and are formed by reacting ethylene oxide with a high molecular weight polypropylene glycol. Another type known as *Ucons* are made by simultaneous addition of ethylene oxide and propylene oxide to a diglycol, the rates of addition of the

(*Continued on page 260*)

Lactic Acid Purified by New Solvent Extraction Process





Left: Flow diagram of the new solvent extraction process. Right: The solvent extraction plant. The extraction column is on the left and the solvent stripping column on the right.

WHAT is thought to be an entirely new purification process for lactic acid has been developed at the Widnes works of Bowmans Chemicals Ltd. Based upon solvent extraction, the process was devised by the company's technical manager, Mr. C. G. Childs, M.SC., A.R.I.C., who also supervised the design and construction of the plant which cost something under £25,000. When its development on a large scale came to be worked out it was realised that the change from batch to continuous operation which it involved would enable other new purification techniques to be introduced.

Bowmans produce lactic acid by the anaerobic thermophilic fermentation of sugars at 50°C. The product is a dilute calcium lactate containing a number of complex impurities. The conventional purification process involves an elaborate sequence of coagulation, decolorisation, crystallisation, acidification, removal of heavy metals, and evaporation under vacuum, a number of these processes being repeated. In the new process the dilute calcium lactate from fermentation, after removal of bacterial protein, is acidified and calcium removed as the sulphate. The dilute lactic acid is then decolorised in activated carbon columns which are regenerated in sequence. Regeneration of carbon of this type is thought to be entirely new, and, together with other features of the process, has been patented. The dilute acid is then freed from residual calcium, amino-acids and traces of heavy metals by percolation through ion-exchange resin, which is regenerated in the usual way. The purified acid is then evaporated under vacuum to a concentration of 90% and the product extracted in counter-current with isopropyl ether as the solvent. The enriched solvent is then re-extracted in counter-current with distilled water, and the stripped solvent re-circulated to the extraction tower. Solvent loss is approximately 1%. The resulting pure aqueous extract is given a final decolorisation and ion-exchange treatment, and is then ready for sale or for further evaporation to the strongest grade.

From the extraction tower onwards the acid is handled only in glass, stoneware, plastic or rubber lined equipment. Development of the plant from the laboratory to the present stage has taken three years.

Lactic acid for chemical synthesis

An important result of the new purification process is that it brings lactic acid fully into the picture as a raw material for chemical synthesis. As α-hydroxypropionic acid, the simplest aliphatic hydroxy acid readily available, it has potentialities which are only just beginning to be explored. Less obvious is the fact that its metallic salts are weakly co-ordinated and usually highly soluble, making them of particular use in fields where it is desirable to provide a heavy metal in strong solution from which it can be readily precipitated.

Apart from its use in the food industry, lactic acid, as calcium lactate, has been found to give a considerable increase in egg production when used as an additive to poultry feeds. Added at a level of rather under 1% to the laying ration, it is said to give increases of up to 15% in egg yield over the year's lay, without any increase in food consumption, although there is usually a slight decrease in average egg size.

The lactate appears to function in this, and in all dietary applications, by altering the intestinal environment, so that favourable bacteria are encouraged to multiply and produce a condition in which there is improved digestion and assimilation of the ration.

A somewhat different application of lactates for livestock pioneered by Bow-Calac Ltd. is the use of calcium sodium lactate both for preventing and curing cattle acetonæmia and twin-lamb disease.

Plastics and Rubbers in Chemical Plant

By T. A. Watson, B.SC., A.R.C.S., A.M.I.CHEM.E.

The variety of plastics and rubbers increases each year and the outsider is bound to get a confused impression of their performance and uses. In this article the author summarises the ways in which high polymers are used in chemical engineering and attempts to assess their advantages and drawbacks. Rubbers have been used as chemically resistant linings for vats and tanks for many decades and thick bitumen and pitch coatings have been used for similar purposes. Polythene and P.V.C. sheet and tube materials are now widely used for the conveyance of corrosive liquids and for fume extraction systems. Much publicity has been given to glass reinforced resin structures and these too are finding acceptance as storage tanks, etc. They are the only plastics so far developed which are likely to achieve much success as a structural material for chemical plants.

ALTHOUGH the plastics industry has grown phenomenally since the war both in the range and volume of its products, the application of these materials to chemical plant has not by any means increased proportionately.

Reasons for this are not hard to find. Structurally plastics are much weaker than metals, although on a strength : weight basis some glass-reinforced plastics may approach the strengths of light alloys in short-term tests. But, of course, metal units are bound to be more robust than plastics alternatives and are much better able to withstand careless handling and rough usage during installation. Finally, most useful plastics are much more expensive than the metals they might replace.

On the other hand, there are three properties of plastics which make them of value for chemical plant, *viz.* chemical resistance, freedom from corrosion, and light weight. In addition, their good electrical insulating properties and, in some cases, their optical transparency may be of value.

There are two main groups of plastics, namely thermoplastic and thermosetting plastics. The former group continues to gain ground commercially over the latter, since the processes used for their fabrication are more rapid and therefore less expensive in labour. Thermoplastic articles may be injection moulded, extruded, vacuum or pressure formed from sheet, or assembled from unit sections employing welding or solvent sealing techniques.

Thermosetting plastics are normally compression or transfer moulded, although some assemblies have been built up by sticking together laminates or other shapes with adhesives. More recently liquid resin-catalyst systems which give solid plastics have been applied more widely to the fabrication of structures employing glass or similar fibrous material as reinforcement.

This 4-in. valve for chemical plant is cast throughout in *Araldite* casting resin B.

Thermoplastics

Thermoplastics can have tensile strengths ranging from 1,000 to 11,000 p.s.i. at ordinary ambient temperatures. The tensile strength varies with the type of plastic and the degree of plasticisation. Normally, a plasticised material has lower tensile strength but higher impact strength and elongation when compared with the same polymer unplasticised.

Most thermoplastics soften at relatively low temperatures and few can be used continuously much above 60°C. Provided oxidation can be prevented certain nylons have useful mechanical properties up to about 140°C.

Polytetrafluorethylene (P.T.F.E.), which is the most heat-resisting thermoplastic available, can be exposed to 250°C. continuously, although its tensile strength (2,000 p.s.i. at ambient temperatures) is poor.

Most thermoplastics have good resistance to aqueous chemicals and some even to strong acids, but in general they are very susceptible to organic liquids.

Thermosetting plastics

Thermoset resins themselves have poor mechanical properties, but by the intelligent use of fibrous reinforcing fillers moulding materials with good tensile and impact properties may be prepared. The range of mechanical properties available from moulded thermoset materials is 4,000 to 15,000 p.s.i. tensile and 0·1 to 10 ft. lb. impact strength (B.S. 771).

Glass reinforced plastics may have tensile strength up to 40,000 p.s.i. and up to 20 ft. lb. impact strength. By suitably orientating the reinforcement of glass or other fibre it is possible to obtain higher mechanical strength in selected directions or planes.

Plastics linings

One result of the relatively poor mechanical properties of plastics is that they are often used as a chemically resistant lining for a metal reaction vessel or similar equipment.

When employing plastics in this way, great care is needed both in the selection of a suitable material and in ensuring that it is properly applied to or assembled with the metal. There are several techniques for lining plant with plastics. For example a prefabricated skin may be stuck to a metal tank or other unit, or a skin may be formed by fusing a powdered polymer on to

(Courtesy "Corrosion Technology")

Left: Four-ft. bell housing, for use in the chemical industry, completely dip coated with PVC $\frac{1}{16}$ in. thick by Durable Plastics Ltd. Above: Ebonite-lined J-tank entering a curing oven.

the hot metal surface. Recently steel coated with P.V.C. sheet has become available; this material is said to withstand forming and similar operations without separation of the plastic. Another popular method for protecting metal surfaces is to trowel a cold-setting resinous composition over the surface, leaving it to cure and harden *in situ*.

In choosing a resin or resin compound for lining it must be borne in mind that most thermoplastics have very serious temperature limitations and all have very high differential thermal expansion compared with metals. On the other hand, thermoset materials tend to be brittle and may continue to shrink after fabrication, so that they eventually crack if free movement is not possible.

This sort of use is not new. Rubber linings both for wooden vats and metal tanks have been used for many years; so have phenol formaldehyde trowelling compositions as tank liners.

It should be remembered that although a coating is chemically resistant it may contain components which will leach into the chemicals employed and seriously interfere with the reaction.

Of the newer materials, both polythene and P.V.C. are of importance for linings. Where cost has been of secondary importance, P.T.F.E. has scored some spectacular successes, provided that a non-porous coating has been achieved.

Piping and trunking

Undoubtedly, the most rapidly growing field for plastics in the chemical industry is that of ancillary units and items, such as valves, piping, ventilation and conveyor trunking, etc.

Rigid P.V.C. has been used for acid-washing towers and similar structures where the weight loading is not high. Polythene or P.V.C. piping may be used to convey most aqueous liquors without difficulty. British Standard Specifications are available for polythene tubing, for water services (B.S. 1972) and for services other than water (B.S. 1973). Other specifications cover auxiliary materials, such as polythene sheet for flanges (B.S. 3012) and polythene rods for welding (B.S. 2919). Specifications for high density polythene tubing and for rigid P.V.C. tubing are in course of preparation. Since the plastics tubing may be integrally coloured at the time of manufacture the colour coding of service pipes in a factory can be simply installed and permanently and surely identified.

Polythene is unsuitable for use with most organic liquids, and although P.V.C. can be used for a restricted range of such liquids it is frequently more appropriate to employ a nylon piping (*e.g.* nylon 6), which is resistant to most organic liquids, notable exceptions being formic acid and all phenols. Nylons, however, are frequently affected by water and provision must be made for the expansion and contractions which occur with changes in atmospheric humidities.

For exhaust systems rigid P.V.C. is widely used, although in some instances where overall weight and stiffness are important, glass fabric reinforced polyesters have been used. P.V.C. trunking is frequently made by forming flat sheet *in situ* by means of heat and then sealing lengths together with a suitable cement. Alternatively, edges may be flanged and bolted together. Piping is also available in a wide range of diameters. This type of end use is likely to be challenged in the future by high density polythene and polypropylene, both of which soften at an appreciably higher temperature than P.V.C.

P.V.C. has also been used for exhaust fan blades, although for small units phenol formaldehyde (*Bakelite*) mouldings have long been used. The latter material has shown relatively good ageing behaviour when exposed to the weather, a property not always inherent in thermoplastics.

Gland packings and other uses

Highly plasticised P.V.C. compositions are used for gland packings, although in cases where the chemical requirements are very severe P.T.F.E. or other fluorinated polymers may be preferred.

Corrosion Resistance, Properties and Uses of Rubber

Material	*Corrosion resistance*	*Approximate ultimate tensile strength (p.s.i.)*	*Approximate hardness (Brinell)*	*Impact strength (Izod)*
Ebonite	Natural and synthetic rubber ebonites withstand a wide range of chemicals, chief exceptions being mineral oils, certain solvents, and exceptionally strong oxidising agents. Ebonites made from nitrile rubbers are highly resistant to mineral oils and solvents.	Up to 10,000	10 to 24	1 to 7·5 about 32°F.
Glass-fibre-reinforced plastics	Depends chiefly on the resin used. Epoxide resins have generally good chemical resistance, and furane resins have exceptional resistance to alkalis.	20,000 to 120,000		20 to 70
Neoprene	More resistant to oils, oxidising agents and weathering than natural rubber.	3,000 upwards		
Nylon*	Resistant to many inorganic chemicals, but not suitable for use with mineral acids, hypochlorites, permanganates or hydrogen peroxide. Resistant to alkalis. Good resistance to organic solvents. Some exceptions are acetic and formic acids, phenol, cresol, and at elevated temperatures benzyl alcohol, nitrobenzene, ethyl acetate and butyl acetate.	5,000 to 40,000	8 to 12	0·6 to 4·7
Polythene	Unattacked by most chemicals at room temperature and resistant to solutions of inorganic salts up to 212°F. At temperatures above 140°F. becomes increasingly soluble in aliphatic, aromatic and chlorinated hydrocarbon.	1,200 to 2,000	2	18 to 20
Polythene (high-density)	Similar to polythene but more resistant to solvents and can be used at higher temperatures.	4,200	6	2 to 20
PTFE (polytetrafluoro-ethylene)	Unaffected by all chemicals except molten alkali metals and fluorine at elevated temperatures and pressures. May be used up to 250°C. (482°F.).	2,000 upwards		
PVC (unplasticised)	Resistant to moist solutions of inorganic salts at temperatures up to 140°F., also 50% nitric acid, 90% sulphuric acid and hydrochloric acid. Some organic chemicals attack the material: examples are acetone, benzene, cyclohexanol methyl chloride, trichloroethylene.	7,000 to 8,000	12 to 15	2 to 5
PVC (high-impact)	*See above.*	5,000 to 6,000	10·6	15
Rubber (natural)	Withstands a large range of chemicals in general use. Chief exceptions: mineral oils, the majority of organic solvents, and very strong oxidising agents, but resistance to many of these can be provided by the use of special-purpose synthetics.	1,000 to 3,500		

* Physical properties are for the moulding material.

We acknowledge with thanks the co-operation of the following companies and organisations in supplying information for this chart: British Geon Ltd. (high-density polythene, high-impact PVC); British Hydrocarbon Chemicals Ltd. (polythene); Crane Packing Ltd. (PTFE); Du Pont Co. (United Kingdom) Ltd. (neoprene); Federation of British Rubber and Allied Manufacturers (rubber, ebonite); Fibreglass Ltd. (glass-fibre-reinforced polyester); Imperial Chemical Industries Ltd. (unplasticised PVC, polythene, nylon); Nylonic Engineering Co. Ltd. (nylon). Reproduced by permission of "Chemical and Process Engineering."

In corrosive environments gears of phenolic laminates and of nylon have many advantages over their metal counterparts. Their good electrical insulating properties and chemical resistance make plastics the materials of choice for electrical installations in chemical plants.

Plasticised P.V.C. is widely used in the chemical industry for protective clothing, gloves, boots, etc., and for acid-resisting flooring. For heavy duty, the P.V.C. is frequently applied to a textile base.

Glass-reinforced plastics

The most significant development in structural plastics is the use of glass-reinforced polyesters for storage, working, and conveyor tanks for chemicals. Larger tanks are usually fabricated by assembling standard sections, while smaller tanks and conveyor tanks for vehicles are made seamless. Assembled tanks frequently employ flexible plastics as packing sealants between sections.

There are many problems associated with this sort of application which have to be solved to get satisfactory results. Apart from fabrication problems, which are outside the scope of this article, there is the important one of choosing a resin system. In evaluating any plastic for chemical resistance, it is desirable to study its chemical behaviour under stress. The chemical resistance to solvents, etc., of a stressed component is frequently very different from that of an unstressed one made from identical materials. The performance of a filled plastic too can be quite different, especially after the surface film of resin has been abraded or eroded away.

In general, any polyester resin system will give better chemical resistance if it is fully cured. Frequently this result can only be achieved by applying a post-curing operation to the cold cured item.

When considering plastics as materials of construction it is impossible to rely solely on their strength properties as indicated by short-term laboratory tests. This applies to all plastics, not least to glass reinforced plastics which have been widely acclaimed as structural materials. Dependent upon the particular resin-glass system employed, reinforced plastics will withstand only 30 to 40% of their ultimate short-term mechanical strength if the load is to be applied for long periods of time. In many cases too the effect is cumulative. Temporary overloading, although well below the ultimate strength, may shorten the useful life of a reinforced plastic structure.

During use additional stresses may be set up by the expansion and contraction caused by temperature gradients through the structure. Similarly the mechanical properties may be markedly affected as a result of the absorption and desorption of water into the resin-glass system.

On the other hand, the versatility of the processes for making up tanks and other pieces of plant from glass-reinforced plastics warrants every consideration being given to the employment of such material, especially when only one or two vessels of a particular kind are required.

Frequently the ease of fabrication has been overemphasized, but nevertheless the ability to strengthen particular areas and to protect certain surfaces with additional or specially chemically resistant resin during manufacture is very attractive.

Although the use of unsaturated polyesters has been emphasised here, there are several other important resins in this field, namely epoxides, low-pressure phenolics and silicones. Each has its advantages and limitations, but the wider use of the polyester is undoubtedly due to its relatively low price and ease of handling.

It must be emphasised too that there are enormous variations in resin properties and behaviour, even within the various classes. Factors

and Plastics for Chemical Plant and Equipment

Specific gravity	*Thermal conductivity (B.Th.U.)/(hr.) (sq. ft.) (°F./ft.)*	*Coefficient of linear expansion (per °F. × 10⁻⁶)*	*Special remarks on fabricating properties*	*Main applications in chemical plant*
1·13 to 2·0 or more	0·08 to 0·16	40	Moulded, hand-built or machined by the usual techniques.	Pipes, linings, valves, pumps, buckets.
1·5 to 1·9	0·1 to 0·25	5 to 18	Shaped by various moulding techniques and by casting. Carbide-tipped tools are recommended for machining and abrasion discs are recommended for sawing.	Fans, ducting, pipes, drying traps.
1·2 to 1·5	0·11 to 0·12		*See Rubber (natural).*	*See Rubber (natural).*
1·04 to 1·15	0·14	60 to 100	Easily machined. Usually joined by threading or by special cements. Can be used up to 245°F. or up to 300°F. in certain circumstances.	Valve seats, piping, filter cloths, lubricant-free gears and bearings.
0·92	0·19	160	May be moulded by injection or compression. Joined by fusion or hot gas welding. In contact with some organic polar liquids, certain grades may be subject to stress cracking.	Pipes, vessels, tank linings, valves, containers.
0·96		130	*See Polythene.*	Piping for effluents and corrosive liquids, also tanks.
2·1 to 2·2	0·14	55	Normally compression moulded, but fabricated by special extrusion techniques.	Tubing, gaskets, dispersion coatings, pump and valve packings, bellows.
1·41 to 1·45	0·1	45	Joined by special cement or hot gas welding. May be moulded at 230 to 265°F. or can be extruded.	Welded tanks, heat exchangers, pipes, valves, fittings, ducting, fume cabinets.
1·3 to 1·4	0·1	50	Notch sensitivity less than for normal rigid PVC.	Pipes, tubes and fittings.
0·95 to 2·0 or more	About 0·08	120	In lining vessels, care must be taken that air is not trapped between the rubber and the vessel. Surface of vessel must be carefully prepared before lining.	Tubing, tank linings, gaskets.

IMPORTANT: It is not possible, in the space available, to give comprehensive data for all the various grades of the materials listed; each material is therefore treated on its broad merits and only the order of properties to be expected is indicated. Where it has not proved possible to give typical physical properties, figures are given for one well-known grade of the material in question.

like water resistance, electrical and heat resistance, abrasion resistance, etc., can be varied over a wide range by relatively small changes in the resin composition and its method of preparation. For certain applications the proper selection of the type of glass reinforcement to be used may be critical.

Cements and adhesives

Another important use of plastics in chemical plant is in the preparation of cements for sealing chemically resistant bricks and tiles, etc. Here the choice of material is very wide, although preference is usually given nowadays to thermosetting materials. Frequently a cold-setting mix is employed and both furane and phenolic polymers have been extensively used.

When they are more fully evaluated and understood there is little doubt that many synthetic resin adhesives will become important in chemical plant. It is possible to replace riveted joints in metals by resin bonds of equivalent strength, and provided that the temperature requirements are not onerous such joints should give good performance.

Synthetic fibres

Fibres and fabrics prepared from synthetic polymers have gained wide acceptance for use as filter pads and cloths. Compared with the natural products which they have replaced they show advantages in respect of chemical resistance and higher mechanical strength. Further, their characteristics are more consistent and reproducible.

Rubbers

In addition to their use as protective linings for vessels, rubbers are widely used in glands, gaskets, flexible hoses and bellows. The advent of synthetic rubbers has widened the possible field of application, although frequently good performance of a rubber component apparently depends on a compromise between the leaching out of certain components from the rubber and the absorption of other chemicals by the rubber from the materials being processed. A proportion of many of the compound ingredients may be extracted from the rubber during its working life and this may lead to its rapid deterioration and also to undesirable contamination of the material being processed. Terms such as "oil-resistant" should be treated with reserve; usually it means that the synthetic rubber swells 20% or so when in contact with a particular oil, compared with a much higher figure for natural rubber. As explained earlier, however, this 20% swelling may be the net result of, say, 10% leaching and therefore some 30% absorption of oil has occurred.

Synthetic rubbers may be selected on account of such properties as improved resistance to oxygen and ozone, *e.g.* butyl rubber, or for improved chemical resistance, *e.g.* chloroprene (Neoprene).

Future developments

In a field that is changing and expanding as rapidly as plastics, it is always difficult to visualise the changes that may occur in the near future. New materials are frequently appearing and almost every one of these is claimed to have outstanding properties in one direction or another. Realistic evaluation must always be a slow process, since accelerated tests may frequently give misleading results, whilst in addition unforeseen limitations often arise in practice. However, until plastics are available which have much improved mechanical properties and much better resistance to high temperatures than anything so far known, it seems unlikely that any further large-scale replacement of metals by plastics in chemical plant can occur. Meanwhile, within the field of established uses for plastics in chemical plant there will certainly be much juggling for position between established polymers and those which are likely to become available in the near future.

Rubber and Ebonite Linings

By a Special Correspondent*

ONE great advantage of rubber, whether soft or hard, as a material for protecting chemical equipment against corrosion is the strength of the bond by which it can be attached to metal during the vulcanising process. Ebonite—which is simply rubber vulcanised with a high proportion of sulphur—will bond direct to steel, the molecules of sulphur combining with the metal on one side and the rubber molecules on the other to form a true chemical bond. Shortly after the first world war bonding agents were developed which effected a similar chemical bond between soft rubber and steel or other metals. Since then the use of rubber and ebonite linings in all branches of the chemical industry has developed enormously.

The high bond strength obtainable with rubber makes it particularly suitable for vacuum conditions on the one hand, and for high-pressure vessels on the other, since on the sudden release of pressure it resists any tendency to peel off or blister. It is also extremely valuable for covering such things as stirrers, fans, impellors and centrifugal baskets.

Choice of material

The choice between rubber and ebonite depends largely on conditions of service. Soft rubber has a greater abrasion resistance than ebonite, and is therefore useful for such things as crystal suspensions, or where there is a possibility of mechanical damage. Ebonite, on the other hand, has a somewhat higher chemical resistance than soft rubber, and can more easily be compounded to avoid staining or contamination of the liquors contained. It can also if necessary be polished to a smooth finish, which is invaluable when dealing with sticky or oily fluids.

For the rest the hard-and-fast distinction between rubber and ebonite is rapidly becoming out of date. Rubber linings are now available at any degree of hardness from the softest anti-abrasive formulations, through harder rubbers and flexible ebonites, to the highly-loaded ebonites which are specially compounded for temperature resistance.

Natural rubber linings, whether hard or soft, are resistant to a very wide range of inorganic chemicals, including most inorganic salts, and to a remarkable number of organic chemicals, including alcohols, sugars, glycerin, acetone and ethylene glycol. Where natural rubber is not recommended, as with highly-oxidising acids, and with mineral and vegetable oils and greases, one or other of the newer special-purpose rubbers can be used. In particular chloroprene and nitrile rubbers give resistance to mineral oils, chlorosulphorated polyethylene to some of the more highly oxidising acids and butyl rubber to animal and vegetable oils and fatty acids.

Design considerations

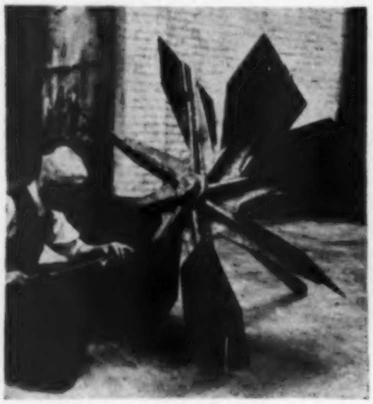
Firms specialising in lining work have amassed not only a great deal of technical knowledge but a vast amount of practical experience. No two lining jobs are exactly alike, and no one formula will entirely cover the practical problems that invariably arise. Chemical linings must, therefore, be entrusted to a specialist. It is easy to look up the chemical resistance of rubber in a textbook—but quite another matter to design the precise compound which alone is suited to the particular situation.

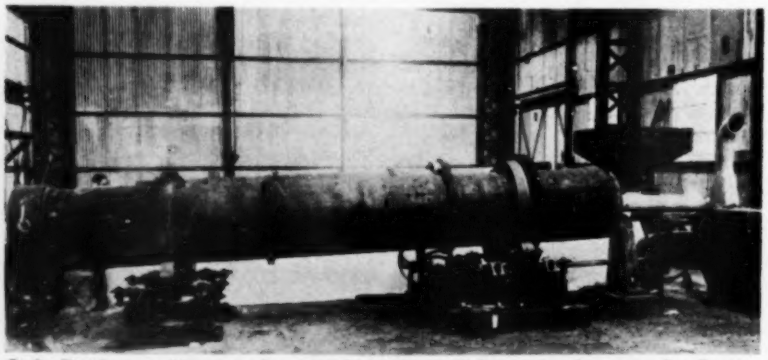
The specialist must " know all " —the chemicals to be handled, the purposes for which they will be used, the temperatures of operation, the presence of abrasive materials, etc. Sometimes a lining which will withstand an alkali or acid separately may break down if exposed to alternations between the two. The presence of ingredients in the liquor in mere trace quantities can have a cumulative effect on the lining out of all proportion to the minute percentage present.

Unless the designer is very sure of his ground it is wise to consult a specialist on the materials and construction of equipment intended for lining. A small modification at the design stage may make the process of lining easier and more efficient and possibly effect savings in costs of maintenance as well as original construction.

Equally important is the design of the vessels to be lined. Mild steel tanks should conform to the relevant British Standard specifications, B.S. 2594: 1955, and for pressure vessels B.S. 1500: 1949. They should if possible be of welded construction,

* Of the PLANT LINING GROUP of the Federation of British Rubber and Allied Manufacturers. Members of the Group are: B.T.R. Industries Ltd., Dexine Rubber Co. Ltd., Dunlop Rubber Co. Ltd., Nordac Limited, Redferns (Bredbury) Ltd., St. Helens Cable and Rubber Co. Ltd.





Left: Putting a rubber covering on a fan to be used for extracting corrosive fumes
Above: Rubber-lined rotary dryer for chemicals.

the welding continuous, free from porosity, cracks, crevices or any places where air or foreign matter could be trapped. All sharp corners and angles should be avoided. If necessary, fillet welds should be used on corners, and all angles smoothed to a radius of not less than ¼ inch.

Lining techniques

The linings are applied in the form of uncured sheet, and carefully rolled on by hand. The whole is then vulcanised under heat and pressure in a vulcanising "pan" or autoclave. Pans for the purpose, at the premises of rubber companies which specialise in lining work, may be up to 15 ft. in diameter and from 20 ft. to 25 ft. in length. Vessels which are too large to go into such an autoclave may be built and vulcanised in flanged sections, or vulcanised by steam or other means on site.

Pipes made of steel can be lined with either rubber or ebonite, thus combining the strength of steel piping with the abrasion and corrosion resistance of rubber.

Pumps, valves and cocks can be lined with either soft rubber or ebonite. Ebonite has the advantage of being easy to machine to close tolerance *after* vulcanisation. In the smaller sizes fabricated ebonite pumps, valves, pipes and fitments are available, and if they are properly supported and not required to work at high temperatures they have a remarkably long life.

Plant and Equipment in Rubber and Plastics

New plastics

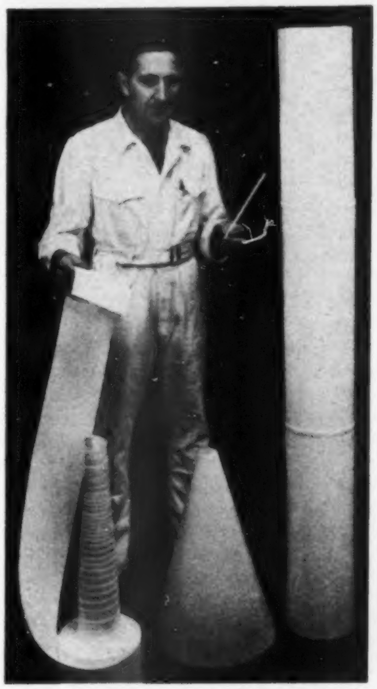
TWO new rigid p.v.c. compounds for extrusion applications are available from the Plastics Division of Imperial Chemical Industries Ltd. One, *Welvic R7/79*, is an unplasticised p.v.c. compound with an improved impact strength over that of the *Welvic R7/20*. Both the compounds are said to possess the properties associated with rigid p.v.c., such as chemical resistance and outdoor weathering.

The other new compound, *Welvic R7/80*, is a rubber-modified rigid composition said to have an extremely high resistance to impact, but in common with all rubber-modified compounds its chemical resistance, outdoor ageing, rigidity and tensile strength are somewhat inferior to those of unmodified p.v.c. All three *Welvic* compounds, *R7/20*, *R7/79* and *R7/80*, can be machined, and fittings can be made by fabrication and moulding techniques.

Melinex and *Terylene* polyester fibre are also manufactured by the company, and hose constructed from these materials is said to handle liquid oxygen and high strength hydrogen peroxide satisfactorily.

Propathene, a new polymer of propylene is also available from I.C.I. This has a relatively high melting-point (165°-170°C.), and is said to have high stiffness and excellent chemical resistance, including apparently complete freedom from environmental stress cracking. With a specific gravity of approximately 0·90 gm./c.c. it is the lightest of commercially available plastics.

According to the manufacturers *Propathene* may be considered for chemical pipes and tank linings, valves and pumps, offering new fields of heat resistance.



Vyon, a new porous plastic material, is made from high density polyethylene.

Sheeting made by extrusion from p.v.c., toughened polystyrene, polythene of low or high density and other materials, with special applications in vacuum forming and constructional work, will shortly be available from the Telegraph Construction and Maintenance Co. Ltd. They also manufacture *Telcovin* tubing for piping chemicals.

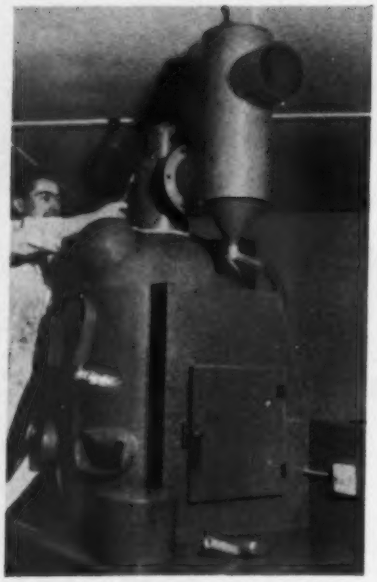
What is claimed to be a new porous plastic material with many possible uses is manufactured by Pritchett and Gold and E.P.S. Co. Ltd. Produced from high density polyethylene of the Ziegler type, the new material, *Vyon*, has already found application in air and liquid filtration, air fluidised powder conveying, and as aeration pads and electrolytic diaphragms. According to the manufacturers, although the product is tough and flexible, it is also light and easily fabricated. It is machinable, and can be welded and drilled. A permeable material of medium pore size, its permeability is uniform and can be controlled in manufacture. It is said to have excellent chemical resistance to a wide range of aqueous solutions.

Fume cupboards

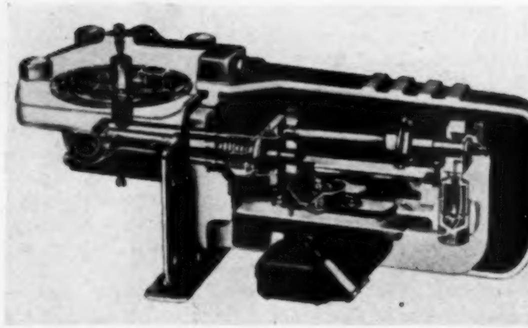
Non-inflammable *Cobex*, manufactured by BX Plastics Ltd., reinforced with expanded metal, has been used to make two fume cupboards recently installed by Tanks and Linings Ltd. for the Ever Ready Co. Ltd. and the Washington Chemical Co. Ltd. Both cupboards are completely made from *Cobex*, including the angle framing and ducting which house the extractor fans, so making the whole installation corrosive resistant.

P.V.C. Fans

The Sturtevant Engineering Co. Ltd. in conjunction with Acalor (1948) Ltd. have produced, in addition to the range of moulded p.v.c. fans based on their original *Monogram* series, a range of fans to handle corrosive fumes and gases based on their original *D* series. These fans have been designed to meet the need for exhausting corrosive fumes and gases and have an all-p.v.c. casing with clad impellor, the impellor and base being of standard design, the unit being of robust construction. They are an alternative to the all-fabricated p.v.c. fan. It is stated that safe, high operating speeds and greater efficiencies can be obtained in many



Left: Hydrotron vapour blasting unit fabricated from Vybak industrial rigid p.v.c. sheet made by Bakelite Ltd.



Right: This differential converter has a Fluon-coated diaphragm.

instances than with the fabricated p.v.c. impellor. An all-p.v.c. fabricated impellor will shortly be available as an alternative.

The Nos. 1, 2 and 3 Sturtevant/Acalor all-moulded p.v.c. *Monogram* fans are now all available ex stock, and have recently been reduced in price.

High temperature ebonite

The Dunlop Chemical Plant Group have developed an ebonite which will operate at temperatures higher than normally specified for ebonites, *i.e.* at temperatures up to 100°-110°C., whereas the previous specified operating temperature was not more than 70°C. The ebonite in question is said not to harden out to any appreciable extent after long periods of operation.

The company also make a polythene/rubber laminate. This is formed by a chemical linkage of high density polythene to rubber backing material. For application to metal the rubber is used to provide a suitable medium for the normal rubber bonding process, and it also has the dual purpose of providing an expansion control between the polythene and the metal. Development work on production techniques is still proceeding, but regular rectangular or cylindrical vessels can now be lined satisfactorily.

In addition to the corrosion-resistant properties of polythene use is made of its non-stick properties in the lining of powder hoppers, etc., where "bridging" has previously prevented the discharge of powders.

High density polyethylene

Rigidex high density polyethylene is shortly to be produced in the United Kingdom by British Hydrocarbon Chemicals Ltd. and it is now being sold on their behalf by British Resin Products Ltd. It is stated to be a highly crystalline material and thus harder and more rigid than ordinary polyethylene. According to the manufacturers it can be processed by all the accepted methods for handling thermoplastics.

Apart from its inherent stiffness, the material is said to be tough, durable and abrasion resistant, and to be inert and resistant to water and a wide range of chemicals, solvents, oils and greases. Products made from it can be sterilised at 100°C. It is also claimed to retain its mechanical properties at temperatures down to −70°C. and to have a low liquid and moisture vapour permeability.

The company also manufacture *Styron* 700 and 440, two new heat-resistant polystyrenes, *Hycar* nitrile rubbers and *Geon* p.v.c. pipe, suitable for corrosive effluent disposal.

Protective coatings

Pliolite S-5 is a styrene butadiene resin produced by the Goodyear Tyre and Rubber Co. Ltd. Used in corrosion-resistant finishes, it is said to be particularly resistant to both weak and strong acids and alkalies, vegetable, animal and mineral oils, and greases. The manufacturers state that on exposure to a temperature of 300°F. for extended periods it shows no apparent breakdown.

Dip-coating with *Telcothene H.D.*, a new product from the Telephone Construction and Maintenance Co. Ltd., is said to give a tough and durable anticorrosive coating. Although recommended for utilitarian purposes in industry, it is also available in a range of colours for decorative effect and identification.

Laboratory equipment

Universal Kjedahl equipment made by A. Gallenkamp and Co. Ltd. is available with the vapour tube and fume extraction plant fabricated in polythene. The fume extraction plant consists of a welded polythene ejector unit, connecting sleeve, hose clips and sufficient flexible hose to couple the fan at floor level with the digestion unit standing on a 3 ft. bench. The plant is stated to be sufficiently powerful to extract fumes from two vapour tubes in series. The ejector unit is flanged for connecting to the vapour tube and the outlet connects directly to a 4 in. dia. flue pipe.

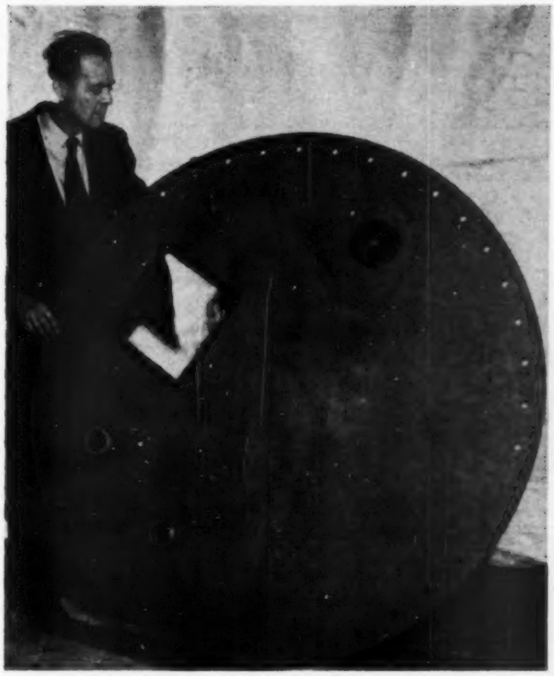
The vapour tube is 4 in. dia. and of welded construction flanged at both ends, with six holes to take digestion flasks up to 800 ml. capacity. It is supplied with stainless steel nuts and bolts for making joints at both ends.

A wide range of equipment in rubber, polythene, p.v.c. *Neoprene*, *Perspex*, nylon and p.t.f.e. is available from the Laboratory Apparatus and Glass Blowing Co. Ltd. It includes tubing, storage bins, beakers, filter funnels, sink traps, tanks in capacities ranging from 6 to 100 gal. and valves.

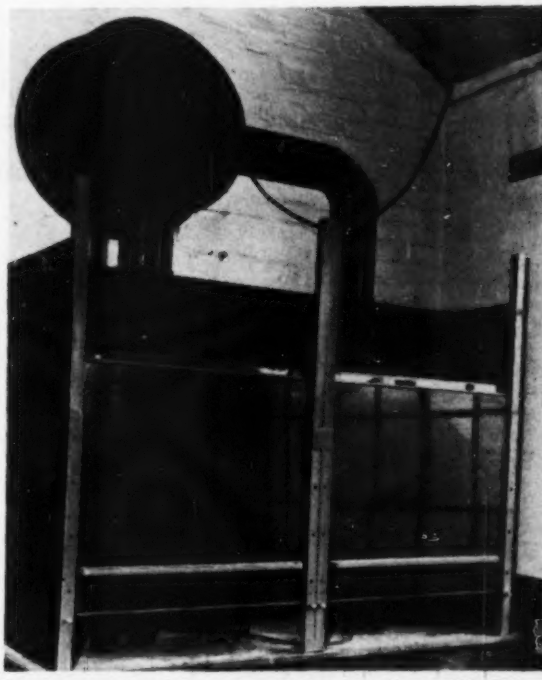
Plastic lined pumps

The same company makes a series of pumps. These are fabricated in cast iron, stainless steel or non-ferrous materials, and have p.t.f.e. plungers and packing glands. One model is lined entirely with p.t.f.e., making it suitable, it is claimed, for pumping nearly all liquids at temperatures up to 200°C.

Crane Packaging Ltd. have developed a pump for use with highly corrosive chemicals, in which all parts which come into contact with the fluid are made from *Fluon*.



This metal cover is lined with a polythene/rubber laminate made by Dunlop.



This fume cupboard is constructed in non-inflammable *Cobex*, reinforced with expanded metal.

The pump has been designed mainly for use in laboratories on short-term experiments, to provide highly corrosive liquids or gases at a predetermined pressure, or as a metering pump providing an infinitely variable flow over the delivery range. The pump is set to a predetermined pressure by a pressure reducing valve in the air supply. It is claimed that as a metering unit an accuracy of $\pm 2\%$ has been maintained in test runs. It can also be used in a production plant where service conditions are light.

The pump consists of a bellows made of *Fluon* which is blanked off at one end, the other end forming a valve chest incorporating two conical seat gravity valves. Motive power is supplied by a reciprocating air motor with a fully adjustable stroke and sensitive throttle control. The pump unit is directly coupled to an extension of the piston rod. The pump can be supplied in either single or double ended form. The single pump unit gives intermittent delivery, whereas the double unit will give almost continuous delivery.

Temperature ranges are 40°C. to 80°C. Other temperatures could be considered, but the company advise that their technical department should be consulted before attempting to go outside this range. Pressure range: delivery 0 to 30 p.s.i.; suction lift: 25 in. Hg gauge max.; air consumption: $\frac{1}{2}$ cu. ft./min. assuming 20 strokes/min. at 80 lb./sq. in.; air supply pressure: 50 lb./sq. in. min. 100 lb./sq. in. max. Overall dimensions are: single ended: 17 in. $\times$ 10$\frac{1}{2}$ in. $\times$ 9 in.; double ended: 22 in. $\times$ 10$\frac{1}{2}$ in. $\times$ 9 in.

Spark tester

The *Gee-Bee* portable spark tester, model GBP 20, has been designed to suit conditions in workshops engaged in lining vessels and tanks with rubber, *Neoprene* and plasticised p.v.c. sheet. It is also said to be suitable for outdoor work.

According to the manufacturers, Goodburn Plastics Ltd., the housing of the tester is moulded in polythene and has sufficient flexibility to stand up to rough handling. The high-frequency coil of the instrument is housed in a separate unit which can be plugged into the spark tester by means of a three-pin plug. This facilitates repairs when the coil has burned out, when a replacement coil can be plugged in. The rear end of the instrument carries a knob with a pointer which allows for the adjustment of the high frequency output. The instrument can be used for 220/230 v. mains and for 110/115 v. mains.

The spark tester can be fitted with a flexible probe or a comb-type electrode; the latter is preferred for the testing of large surfaces for pinholes. Probe length is 6 in.

Improved metering

Honeywell Controls Ltd. claimed to have raised flow and liquid level metering accuracies by installing a new high-performance diaphragm on their differential converter transmitters. The " pneumatic balance " differential converter, which previously contained a *Fluon*-coated diaphragm separating high and low pressure chambers, now uses *Viton* synthetic rubber as a diaphragm coating. The manufacturers say that the new diaphragm provides better long-term stability of measurement and higher stability under varying temperatures.

The chemical resistance of the new diaphragm is good, and it can be used to meter alkalies, amines, hydrocarbons, and dilute or concentrated mineral acids. The *Teflon* coated diaphragm remains available as an option for metering substances which might attack the new diaphragm.

DETERGENTS and Detergency

By Leon Raphael, M.SC., F.R.I.C.

Synthetic toilet bars • Detergents in Europe • Liquid detergents British soap consumption • Russia makes a start

Soap versus syndets

THE 1958 recession in the United States affected the detergent industry as it did others, resulting in a drop in sales. Towards the end of the year there was a remarkable recovery, producing figures for that year almost identical with those of 1957.[1]

Table 1. Sales of soap and syndets in million lb.

	Syndets	Soap
1956	2,690	1,285
1957	2,916	1,189
1958	2,925	1,080

Syndets now comprise 73% of the total soap and detergent market and during the next decade it is expected that they will displace soap even further, the proportion rising to 78% in 1963 and to 84% in 1968, by which time total production of detergents will reach 4,750 million lb. Liquid detergents continue to gain popularity and last year they showed the largest increase in sales, rising by 25% over 1957 figures.

Some short-sighted soapers who did not enter the synthetic detergent market have in many cases fallen by the wayside, their places being filled by newcomers who have concentrated on syndet production. Advertising campaigns have helped to push up syndet sales among the public and the latest development offered is the syndet bar, the promotion of which is now in full swing. The big three—Proctor and Gamble, Levers and Colgate-Palmolive—each have a stake in this new field. It will probably not be long before their British associates introduce them to this country. Prejudices to the syndet bar still exist, but are being overcome. The chief objection is that it leaves the skin dry and tacky.

Syndet toilet bars

The problems of introducing syndets to the public in bar form have been studied for 25 years or more. During World War II the U.S. Navy used a syndet bar based on a nonionic, particularly useful in salt water. Later syndets were incorporated with soap into the toilet bar, the degree of soap relacement varying up to 50%. The first such product used was sulphated monoglyceride which foamed well in hard water, but it failed because it defatted the skin and did not rinse freely. The normal feel after soap washing is in part due to deposition of lime soaps which, of course, does not occur in the presence of syndets.

Despite attempts to overcome these shortcomings a complete answer has not yet been found. Limited success has been achieved, but the high price of syndet bars compared with soap has not helped sales. In the U.S. it is estimated that the toilet soap market covers 300,000 tons a year[2] and the competition is fierce. Ideally, the syndet bar must be superior to soap in its detergent action and milder than soap on the skin. Its foaming power, solubility and stability to perfume, colour and other additives should be at least equal to those of soap. The bar should be as resistant as soap to cracking, should be equally lasting and should have a similar density to soap. In addition good lime soap dispersion and neutrality are desirable.

The basic raw materials for the syndet bar should be chosen to resemble physically those of soap and the plasticity should be similar, so that plodding can be operated at a temperature not much above that for soap (*viz.* 100°-106°F). The mixture of syndets or syndet and soap should be odourless, non-toxic and light coloured. The syndets most used are alkyl aryl sulphonates, alkyl methyl taurides and alkyl sulphates. The binder may be soap, dextrinated starch, natural gums or polyglycols. Sulphated alkylolamides have been used as foam boosters. Moisture content is critical even to 0·5%, as such variation can produce a slush or a hard rubber-like material.

Other synthetic surfactants which are being investigated include α-hydroxy stearic acid and α-sulphonated acids neutralised by organic bases. By condensing a primary fatty amine with a lactone, a CH_2 group of a fatty acid soap is replaced by NH. Such a product has many advantages for use in syndet bar manufacture, having amphoteric and germicidal properties. Unfortunately, it is expensive and produces unattractive colours and odours which are difficult to remove. Aluminium soaps of acids containing 14 to 20 carbon atoms together with free stearic acid have to a large extent overcome the defatting action of syndet bars.

European detergent production

European countries are also raising detergent production, the leaders being Britain and Western Germany who are replacing soap by syndets to an increasing extent. The result of this has been increased alkylate production to meet the needs of the industry and American exports of alkylate to Europe have fallen. This in turn has caused a slump in benzene production and price. Until last year American exports of alkylate to Europe continued to increase rapidly and had reached 100 million lb. Canada, another export market of the U.S., has also started indigenous production of alkylate and is at present making 30 million lb. a year. Nevertheless, American manufac-

turers continue to search for new developments in alkylate production. Pentadecyl benzene has been receiving attention as an alternative to dodecyl benzene. Sulphonation by sulphur trioxide is becoming more widespread, providing an alkyl aryl sulphonate with a more stable pH than that produced by oleum sulphonation. A new method of sulphonating paraffins by sulphur dioxide and oxygen may be accomplished by radiation with γ-rays from cobalt 60.[3]

Liquid detergents

Household detergents became widely known and used after the second World War. The first light duty detergents were made from soap flakes over 50 years ago and were popular for washing delicate fabrics. Twenty-five years later, syndets were introduced into these products which were sold as free flowing granular powders containing 40% active ingredient with sodium sulphate and moisture accounting for the balance. The most commonly used syndets were sodium lauryl sulphate and sulphated coco monoglyceride. These products formed neutral solutions unaffected by hard water. They did not irritate the skin and produced adequate foam. Products built with alkaline salts and used for washing heavily soiled articles were called heavy duty detergents as distinct from the former light duty products. Light duty liquid detergents are gradually replacing the powdered products.[4] These are based on nonionics of the alkylated phenol ethoxyether type such as *Lissapol* N, but anionics such as dodecyl benzene sulphonate have been used and are popular because of their greater foaming power. The latter products contain alkylolamides to stabilise and enhance the foam. Dodecyl benzene sulphonate made by oleum sulphonation contains a large amount of inorganic sulphate which reduces the solubility of the active ingredient and a solubiliser such as alcohol is required in the liquid formulation. The more recent sulphonation process using sulphur trioxide results in an alkyl aryl sulphonate with very little inorganic sulphate and has the further advantage of good colour and very little undesirable odour. Other anionics used in liquid detergents are the alkyl ethoxy ether sulphates which are becoming increasingly important. These are highly efficient detergents with good foaming characteristics. They seem to combine the properties of anionics and nonionics. *Triton* X770 is an alkyl phenol ethoxy ether sulphate. This cannot be prepared by SO_3 sulphonation, since sulphonation would preferentially occur on the benzene ring rather than on the ethylene oxide grouping. If chlorsulphonic acid is used, it produces chloride ions making the product corrosive. An alternative and more desirable sulphonating agent is sulphamic acid, but this proves to be expensive.

Lauryl ethoxy ether sulphate is much easier to prepare than alkyl aryl types as there is no complication of an aromatic nucleus. Unfortunately lauryl alcohol is subject to price fluctuations.

Tridecyl alcohol, derived from petroleum via the OXO process, is at present available at an economic price in the States. When condensed with three moles ethylene oxide per mole alcohol and sulphated, an attractive surfactant is produced. The lauryl ether of 1·2 dihydroxy propane sulphonate has recently become commercially available. It combines the properties of alkyl aryl sulphonates and ethoxylates. It is available as both sodium and potassium salts which, having different solubilities, can be used to advantage according to requirements. Lauryl sulphate, which was so widely used in light duty liquid detergents and shampoos, has now given way to the ethoxy sulphates.

The heavy duty products now hold about two-thirds of the total syndet market for packaged products and of these only about one-twentieth are now based on soap.[5] The object of a detergent product is to clean, make and maintain a high standard of whiteness and produce adequate foam. It must be safe to handle, convenient and economical, and it must have an acceptable odour and colour. Excess foam can be troublesome in washing machines, so that this property must be controlled. Corrosion inhibitors are essential to prevent damage to machine parts. A detergent product must be free of caking tendencies and be readily soluble in water. In the formulation of heavy duty detergents the active ingredient comprises 15-30%, the most commonly used surfactant being alkyl aryl sulphonate. Alkaline builders such as phosphates, silicates and sulphate are essential ingredients. Tetra sodium pyrophosphate (TSPP) or penta sodium tripolyphosphate act as water softeners and represent 25 to 50% of the total. 5 to 10% sodium silicate is added as a corrosion inhibitor. Sodium sulphate is generally produced, together with the alkyl aryl sulphonate. It assists micelle formation and in this way aids detergent action. Soil suspending agents, the most usual being carboxy methyl cellulose (C.M.C.), are added, about 1% being adequate. Other ingredients added in smaller proportions include fluorescent dyes to improve whiteness and perfume to mask the undesirable odours of the active ingredient.

Heavy duty liquid detergents are becoming increasingly popular in the States and are just making their appearance in Britain. There are many difficulties in their formulation, the chief problem being to obtain a sufficiently high concentration of detergent and builders in a solution which will remain stable and homogeneous.

A solubilising agent such as alcohol is generally required for this purpose. Ethyl alcohol is the most suitable, although isopropyl alcohol has also been suggested. The latter unfortunately has an unpleasant odour. The potassium salts of complex phosphates are more water soluble than their corresponding sodium salts and may therefore find application in this field. In order to mask any settling out opacifying agents are often added. They have the additional property of making the product look attractive. This is achieved by adding insoluble materials like zinc stearate. Fluorescent dyes used as optical brighteners are not substantive to certain resin-coated fabrics.

Another problem which has required much research is the need for a suitable container. The glass bottle was never really favoured because of its fragility and metal containers corrode readily. Most lacquers used as protective coatings on the metal are dissolved by liquid detergents. The most promising container is made of high density (Ziegler) polythene, now being manufactured on a large scale in this country.

Britain's soap consumption

An interesting survey of the British soap and detergent market has been made.[6] It shows trends of

production and consumption throughout its history. The earliest records go back to 1781, when annual production of soap was 17,000 tons, to meet the needs of a population of 8 millions. During the nineteenth century the removal of the soap tax resulted in a large increase in soap production. Our present population of 50 millions consumes 565,000 tons of soap per year. Soap consumption *per capita* has increased four times in 150 years. It is true that incomes have also increased during that period, but comparing consumption in 1939 with 1957, there is little difference, despite a vast increase in average income. There was a drop in consumption during and immediately after the war, compared with 1939, due to rationing, but since 1950, when soap became again freely available, the figure has risen to its pre-war level and remained fairly constant. It is well known that soap consumption goes hand-in-hand with living standards. The United States, Britain, Canada and Australia are among the countries with the highest *per capita* consumption. India, with very low living standards, has one of the lowest figures for soap consumption. Comparing income level with soap consumption in Britain, it is found that while families in the higher income groups use more soap, the usage is not proportional. Consumption increases to a lesser degree than increase in income. This suggests that the lowest paid workers, in general, have clean habits. Bachelors, whatever their income, spend roughly similar amounts on soap.

Table 2 shows the change in prices and consumption of soap in Britain since the turn of the century.

Table 2. U.K. soap prices and consumption

	General retail prices	*Soap and detergent prices*	*Consumption of soap and detergents (thousand tons)*
1900	100	100	321
1914	109	117	384
1920	272	400	380
1930	171	200	411
1939	179	133	551
1946	218	199	439
1950	262	272	570
1958	382	351	550

Russia enters the race

Following the pattern of other totalitarian states, the Russians have had little time for detergent manufacture. Their *per capita* consumption is about a third of that of Britain. Perhaps washing was considered a bourgeois habit! Lately however they have decided to investigate market possibilities, probably to find outlets for the products of their expanding petroleum-chemicals industry. In 1957 Russian production of vegetable oils and fats was 524,000 tons, of which 355,000 tons were used for soap production. From a survey of their literature,[7] the Russians aim to produce a substantial quantity of surfactants in the next seven years, when they hope to double their domestic consumption.

There are 72 soap factories in Russia and of these only 20 are making toilet soap. The total average production is 3,600 tons a day. Production methods by our standards are, in the main, obsolete. Soap was produced in Czarist Russia during the last century and it would appear that little progress has been made. The Russians are now searching British and American literature and reporting on processes in operation for syndet manufacture. Synthetic fatty acids are being produced from petroleum sources, but so far syndet production is small. By 1965 they aim to be producing syndets sufficient to supply one-third of their total detergent market.

None of their methods appear to be original. They have made alkyl aryl sulphonate from kerosene or from propylene and amylene polymers. Higher fatty alcohols are produced by direct oxidation of paraffin hydrocarbons or by high-pressure saponification of wool fat. The extraction of alcohols from sperm-whale oil is considered to be too expensive. In marketing built detergents, imitations of British and American products are being made. Examples are liquid detergents of the *Teepol* type and nonionics like *Lissapol* N. Sulphonation still follows the out-moded batch processes, but their intentions are to introduce continuous reactors as soon as possible. These developments indicate that before long Russia may be a powerful competitor for our export markets for detergents.

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GLYCOLS AND POLYGLYCOLS

(Continued from page 248)

oxides being varied to change the properties of the final product. The oxides can also be fed separately, for alternate periods, to the diglycol. A higher ratio of propylene oxide to ethylene oxide produces water-insoluble *Ucons*, while a higher proportion of ethylene oxide gives water-soluble products. *Ucons* are mainly used as lubricants in brake fluids.

In all polyglycol productions, when the feed of oxide is stopped, the high temperature is maintained for about 1 hr. to ensure complete reaction. During cooling the alkaline catalyst is neutralised with acetic acid or phosphoric acid.

Polyglycols are designated by a number usually representing the average molecular weight and have been made with molecular weights up to 20,000. However, only those up to 6,000 molecular weight are of commercial importance and find wide use in cosmetics and pharmaceuticals.

Commercial polyglycols are sometimes sold as physical mixtures to combine the properties of low and high molecular weight products. One such material—*Carbowax* 1500—is a mixture of polyglycols 1540 and 300, having an average molecular weight of 500 to 600.

Thiodiethylene glycol (Thiodiglycol) may be briefly mentioned. It is produced by the reaction of hydrogen sulphide on ethylene oxide and is used in permanent wave setting lotions.

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I.C.I. titanium. An illustrated booklet from Imperial Chemical Industries Ltd. describes a number of different applications of titanium for chemical plant. Equipment illustrated includes heating coils, emulsion pans, pickling drums, dryers and heat exchangers. Anodically protected titanium carrying a small impressed voltage is of interest for use under extremely corrosive conditions.

BOOK REVIEWS

Exercises in the Evaluation of Drugs and Surgical Dressings

By E. J. Shellard. Pitman, London. Pp. 158. 15s. net.

THIS book has been written for students of pharmacognosy reading for the examinations of the Pharmaceutical Society or the Royal Institute of Chemistry. Part 1 gives a series of simple exercises in the evaluation of drugs and unmedicated surgical dressings. Part 2 gives notes on these practical exercises, arranged so that the student can understand what he is doing and gain some theoretical knowledge of the subject.

The book is written in a practical, direct style and should be of great help in putting students on the right lines.

Quantitative Analysis

By W. Conway Pierce, Edward L. Haenisch and Donald T. Sawyer. 4th Edn. Wiley; Chapman and Hall, London. 1958. Pp. 497. 46s. net.

THIS is a good example of a type of book which is more commonly used in the U.S. than in Great Britain—namely a detailed textbook designed for teaching analytical methods to undergraduate students. The need for such a book and its acceptance are borne out by the fact that this is the fourth edition (previous editions having been published in 1937, 1940 and 1948).

The book is in five main parts. Part I describes basic analytical tools and the unit operations of analytical processes; Part II deals with analytical calculations, the treatment of data, and the equilibria involved in acid-base, precipitation and oxidation-reduction reactions; Parts III and IV deal respectively with laboratory methods of volumetric and gravimetric analyses; Part V is an elementary treatment of three important instrumental methods—colorimetry, potentiometric titrations, and electrodepositions.

Much of the text has been rewritten for this edition and, for example, liberal use is made of the Lowry-Bronsted treatment of acid-base equilibria. Several new determinations have been added: calcium by titration with a complexing agent; nickel by precipitation with dimethylglyoxime; zinc by electrodeposition; colorimetric determinations by colorimeter or filter photometer; and electrometric titrations with a commercial *p*H meter. An excellent addition is a section on the evaluation of data and the precision of measurements, based on statistical methods for use with small populations. Precision is evaluated by the range of the data, and methods are shown for using the range to justify discarding a result.

In the introduction to the book, which is designed for science students, it is emphasised that its purpose is not primarily to train analysts but rather to give those who will be working with chemical or biological reactions an understanding and appreciation of what is involved in an analysis; to help them to develop habits of accurate manipulation and an attitude of critical appraisal of experimental data; and to teach them the basic analytical methods that every research man must use. The design of this book and the judicious blending of theory with practical detail will do a great deal to ensure that its objectives are attained.

R. E. STUCKEY.

Poisoning by Drugs and Chemicals

An Index of Toxic Effects and their Treatment. By Peter Cooper, F.P.S. Alchemist Publications, London. Pp. 209+x. Price 25s.

THIS book is a ready-reference guide to the toxicology of common drugs and chemicals. The main part of the book consists of some 350 alphabetically-arranged monographs on individual substances, from " Acetazolamide " to " Zinc." Each monograph gives the alternative (including proprietary) names of the compound, followed by notes on its action, its absorption and excretion in the body, its toxic effects, possible effects of massive overdose, suggestions for treating cases of poisoning with the compound, and simple aids to identification. An appendix discusses the more important first-aid measures for use in cases of poisoning, *e.g.* artificial respiration, gastric lavage, the use of emetics and " universal antidotes," etc.

The 15-pp. index includes generic names, proprietary names, chemical names and synonyms, permitting immediate reference to the appropriate monograph. The compact format of the book (no bulkier than the British National Formulary) should make it easy to carry in the pocket, and the distinctive yellow binding should enable it to be picked out quickly when needed in an emergency.

Drug and Cosmetic Catalog 1958-59

Drug and Cosmetic Industry, New York. Pp. 344. $5.

THE twelve sections of this catalogue include a raw materials directory, trade name index, suppliers' addresses, machinery and equipment manufacturers, a list of packagers and packaging materials, legal and statistical sections and a list of the industry's periodicals. There are 14 short articles on subjects ranging from negro cosmetics to the use of nitrogen as a propellant in aerosols, which give some idea of the more recent developments in a number of different fields of cosmetic science.

Three pages deal with the selection of trademarks, trademark aspects of international enterprise and the likelihood of confusion of similar names. The legal section describes briefly the organisation and function of the Food and Drug Administration and gives names of officers and addresses of the U.S. Department of Health, Education and Welfare. The legal requirements for the labelling of cosmetics are also given.

PLANT AND EQUIPMENT

▶TAIL GAS TREATMENT

Englehard Industries Ltd. have developed a system of treatment for the treatment of the effluent produced during the catalytic oxidation of ammonia to yield nitric acid. This consists of the gaseous phase treatment of the effluent over various catalysts designed to promote the reduction of the oxides to nitrogen by reaction with hydrogen or hydrocarbon fuels, or carbon monoxide.

Where hydrogen only is employed as the fuel, the nitrogen oxides are converted to nitrogen and water vapour; in cases where a hydrocarbon fuel is used, carbon dioxide is additionally produced, and occasionally some traces of carbon monoxide. In both cases the fuel is bled into the tail gas stream ahead of the catalytic converter and, dependent on fuel types, the temperature is raised to the requisite inlet level by means of heat exchangers. Oxygen present in the effluent will be reduced to water vapour for carbon dioxide along with the nitrogen oxides. As well as producing a clean effluent, the catalytic reactions are exothermic, giving rise to considerable yields of energy in the form of heat. This energy can be recovered from the effluent stream by a conventional turbo-expander before discharging to atmosphere.

Present trends in reactor design favour a two-stage process; the first stage is operated under oxidising conditions and it is here that the relatively high oxygen content of the normal raw tail gas is reduced to a level in the order of 1-2% by reaction with a calculated deficiency of fuel. After passage through an inter-stage heat exchange a slight excess of fuel is added to the stream before it enters the second catalytic reactor. In this converter it is claimed that reducing conditions obtain leading to almost complete reduction of the nitrogen oxides together with the balance of the oxygen. The useful heat energy derived from these reactions is subsequently recovered in the turbo-expander; the inter-stage coolers normally take the form of waste heat boilers.

Another aspect of this process is the large quantity of relatively high grade nitrogen produced by the catalytic conversion if hydrogen is used as fuel. It would appear that a case could be made, on economic grounds, for considering the recovery and purification of the nitrogen in the final effluent possibly for recycle to ammonia synthesis.

According to the manufacturers the catalysts employed in these processes are capable of operation at high throughputs in the range 30,000 - 60,000 volumes/volume/hour. Units are available in this country and are currently being designed to process tail gas flows of up to 1 million c.f.h.

▶MIXER AGITATOR DRIVE

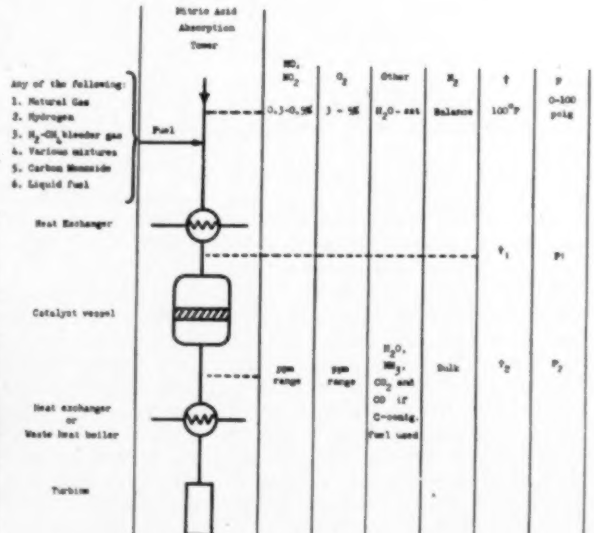
Following a survey of requirements in the fluid mixing field, Stockdale Engineering Ltd. has developed a range of spiral bevel agitator drives, designed specifically for fluid mixing applications.

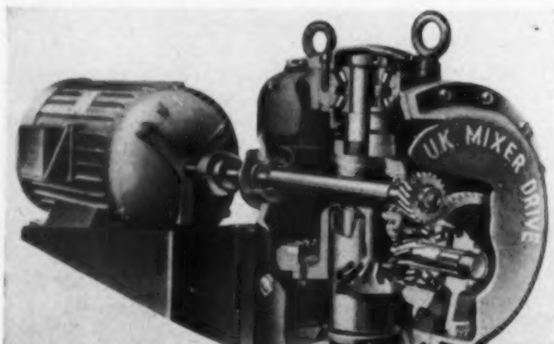
There are five standard units in the range for both open and closed tank operation, and the drive assembly can be "tailor made" to meet special process requirements. The unit has been designed to give continuous, maintenance-free operation.

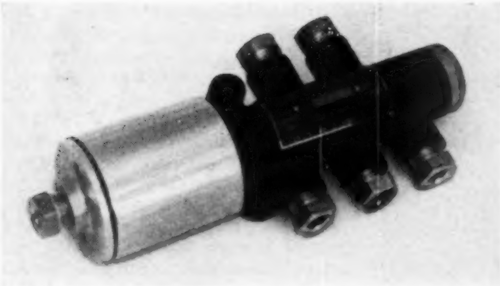
The agitator shaft, which transmits power from the prime mover to the impeller, has been designed for maximum rigidity and minimum deflection between bearings, and it is claimed that long overhung shafts can be used at speeds higher than usual without approaching the critical or shaft whirling speed which can set up excessive vibrations.

Right: Flow diagram of the gaseous phase treatment of tail gas.

Below: The spiral bevel agitator drive.

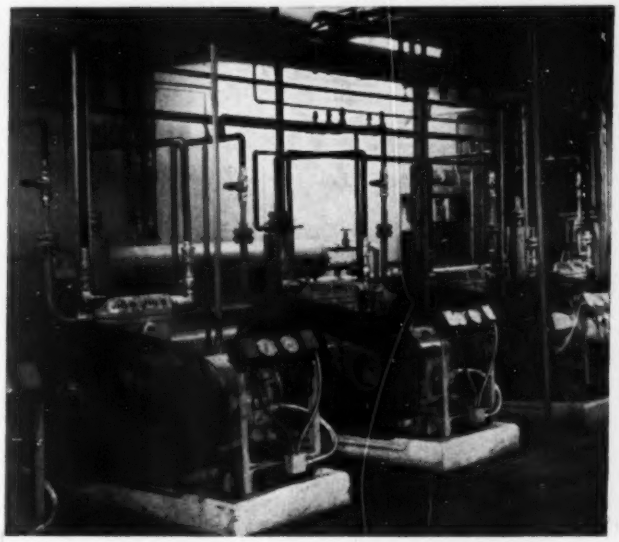






Above: Positive movement of the valve member under extremes of operating conditions is claimed for this Maxam 4-way cylinder-operated valve.

Right: Refrigeration compressors in the air conditioning plant room of the Basingstoke capsule making plant of Eli Lilly and Co. which is described in this issue. Together they deliver 55 tons of refrigerant. Air conditioning is of critical importance to the process.



▶CYLINDER OPERATED VALVES

A new range of cylinder operated valves has been introduced by Maxam Power Ltd. They are designed to ensure positive movement of the valve member under extremes of operating conditions. They are single or double cylinder operated, 2-way, 3-way or 4-way valves of $\frac{5}{16}$ in. and $\frac{1}{2}$ in. sizes.

The large piston area provided by the cylinder is claimed to give a greater thrust to the valve sliding member, a safeguard against out-of-sequence operation resulting from, for example, adverse weather conditions.

▶UNIFORM FLOW FEEDING

A hopper-type of material-feeder, of 2 cu. ft. capacity, is now manufactured in Great Britain by Pulverising Machinery Ltd. Called the *Mikro-Feeder,* it has been designed to give an accurate, constant and uniform flow feeding of any wet or dry substances, other than those which are viscous or semi-viscous. According to the manufacturers it can deal with the uniform non-intermittent feeding of wet, putty-like substances with no danger of the machine seizing or being choked-up, and by simple modification the unit can also deal with pellets or shot-like material.

The feeder consists of a vertical rotating-shaft on which is mounted a circular feed-plate and a 15 in.-dia. steel hopper, 21 in. high. Both plate and hopper rotate as one complete assembly. The rotating-shaft, feed-plate and hopper are mounted on a steel housing over the drive motor and reducer-gear. Secured to this housing is a shearing-knife, which slides between the base of the hopper and feed-plate. When the feeder is in action, the hopper, filled with material, revolves, and the shearing-knife at its base is said to shear off just enough of the substance to maintain a chosen feed-rate.

The thickness of the shearing knife plus the rotation speed of the hopper determine the feed-rate per unit of time. By moving a lever protruding through the housing which actuates the variable feed-plate drive, this rate can be varied, from a few pounds to 5,000 lb. per hr., depending on the density and texture of the substance being handled. It is stated that an accuracy of $\pm 1\%$ can be maintained

▶WET OR DRY COMMINUTOR

The Fitzmill comminuting machine manufactured by Manesty Machines Ltd. consists essentially of a rotor carrying either fixed or swinging blades. Interchangeable screens are fitted below the blades in the chamber containing the rotor. Feed throats are designed so that the material is fed tangentially from above into the orbit of the blades, whose speed can be varied between approximately 1,000 and 4,800 r.p.m.

The mill is claimed to be equally suitable for use with either wet or dry materials, and the chamber may be reversed in order to change the blade from a knife edge to the hammer face whilst maintaining the angle of feeding. Ultimate particle size depends on the speed, the type of blade and blade face, screen and speed of feeding. All parts in contact with the material being ground are of stainless steel.

▶PROCESS ANALYSER

A new process analyser based on the detection of refractive index differences between a process stream and a desired sample is available from the Phœnix Precision Instrument Co. The instrument is a null type designed for continuous operation. A special recorder, based on a repeater principle, operating without batteries and standard cell, is said to save time often required for zero control and re-calibration. The analyser can be supplied with electric or pneumatic proportional controller. Various sensitivities to meet most applications are available combined with a special range extension feature which is said to allow suppression up to 10 times the standard range without initial zero shift or change of reference solution.

Suggested applications include: measuring and controlling impurities in process streams; control of stream blending; concentration measurements; identification of compounds from fractionators.

For more information about the plant and equipment described please use the coupon on page 274

NEWS . . .

Enquiry into œstrogen hazards

The Agricultural Research Council has been enquiring into the possible dangers, whether to man or animals, associated with the practice of administering synthetic œstrogens for the fattening of livestock, including poultry. This investigation is not yet quite complete, but certain points of interest to farmers, however, are already clear.

Stilbœstrol and hexœstrol, the substances used to promote fattening of livestock whether by implantation in the animal or by inclusion in feeding stuffs, are potent drugs which act primarily on the reproductive organs. There is no apparent risk of damage to the animals when the drugs are used on beasts intended for slaughter, in the dosages recommended by the manufacturers. When animals change hands it is always possible, however, that they may be treated more than once, and overdosing might lead to some undesirable side-effects and possibly render the meat less attractive, although not dangerous to the consumer. But since œstrogens will in certain circumstances cause sterility, the use of these substances on animals not intended for slaughter is to be avoided. It is stressed that farmers should ensure in their own interests not only that breeding stock are not implanted with stilbœstrol or hexœstrol, but also that in no circumstances are feeding stuffs containing these hormones fed to them.

These substances can have a serious toxic effect on man when small amounts are swallowed or even inhaled, and attention is drawn to the dangers of home mixing of these materials with other feeding stuffs on the farm. Great care should be taken with all œstrogen-containing substances. They should be kept in a safe place and, in particular, well away from children.

The Council's inquiry includes investigations into the behaviour of synthetic œstrogens excreted by animals. The results of experiments so far obtained indicate that the risk of the contamination of pastures and soil by accumulation is not serious, but until the results have been confirmed the Council cannot positively assert that there is no risk.

Erosion of teeth in industry

Mr. John Boyd-Carpenter, Minister of Pensions and National Insurance, has asked the Industrial Injuries Advisory Council chairman, Prof. Sir Arnold Plant, to consider whether erosion of the teeth due to acid should be a "prescribed disease" under the National Insurance (Industrial Injuries) acts and, if so, for what occupations. The effect of prescribing a disease is that if it is developed as a result of work in whatever occupations may be specified in the regulations, benefit under the Industrial Injuries Act may be paid for the resulting incapacity or disablement.

It has been suggested that the acid given off in some industrial processes, whether in the form of fumes or dust, may damage the teeth of persons working in the immediate vicinity. The Council will be investigating whether, if this is found to occur, the resulting erosion of the teeth satisfies the conditions laid down in the Act for prescription. The question has been referred by the Council to their Industrial Diseases Sub-Committee.

Any person or organisation having information or views on the question should submit them in writing to the Secretary, Industrial Injuries Advisory Council, 10 John Adam Street, London, W.C.2 by September 15. An explanatory memorandum will be sent on request.

European chemical federations centre

For a number of years the directors of the Associations of Chemical Manufacturers in Western Europe have found it useful to meet from time to time to examine together questions of common interest.

In view of the number and scope of the problems facing the chemical industries of these countries at the present time, the Austrian, Belgian, British, Dutch, French, German, Italian, Swedish and Swiss Chemical Manufacturers Associations have decided to improve their collaboration and contacts by setting up a Centre Européen des Fédérations de l'Industrie Chimique (C.E.F.I.C.), the secretarial services of which are entrusted to the Swiss Association in Zurich.

C.E.F.I.C. is a working agency of the directors and will be responsible for organising their meetings and for the exchange of information. Contact with the Centre will be solely through the directors of the member countries.

Control of therapeutic substances

Regulations controlling the sale of (*a*) cycloserine and its salts; (*b*), all derivatives of cortisone, hydrocortisone, prednisone, and prednisolene respectively with hydroxyl or alkyl groups or halogens as substituents, and the esters and salts of esters of such derivatives; and (*c*), the esters of oleandomycin and salts of such esters, came into force on May 11. The full title of the regulations is the Therapeutic Substances (Control of Sale and Supply) Regulations, 1959, and they bring within the scope of Part II of the Therapeutic Substances Act, 1956, the substances named above.

Agricultural science at Nottingham

The first official party to be shown round Nottingham University's new £225,000 Agricultural Sciences Building at Sutton Bonington was made up of 20 branch managers of Boots the Chemists.

The managers, who came from agricultural areas as far apart as Kirkwall and Newton Abbot, were attending a Farms and Gardens course from April 27-May 1 arranged by the company's Retail Staff Training department.

Their preview of the new building followed a welcome at the School of Agriculture by the Dean of the Faculty of Agriculture and Horticulture, Prof. E. G. Hallsworth, who conducted the tour.

The building provides 38,000 sq. ft. of floor space for instruction and research. More than £50,000 worth of equipment has been installed. The official opening will not take place until October.

Prof. Stoll lectures in London

The eminent Swiss chemist, Prof. A. Stoll, gave a lecture entitled "The Cardiac Digitalis Glycosides" at a meeting of the Fine Chemicals Group, Society of Chemical Industry, held recently at the Royal Institution, London. The President of the Society, Sir Robert Robinson, introduced the lecturer.

Prof. Stoll has for many years had an international reputation for his work on natural products, especially that relating to the subject matter of his lecture, and also in the field of ergot alkaloids. In his lecture he traced developments in cardiac digitalis glycosides from the time of William Withering to the determination of chemical structures carried out over the last few decades.

Prof. Stoll and Sir Robert Robinson were entertained by the Fine Chemicals Group Committee at Brown's Hotel after the meeting, and an opportunity was afforded the diners to express their individual congratulations.

Negotiations stopped

Negotiations between Farbwerke Hoechst and Leek Chemicals Ltd. for the marketing in the United Kingdom of Hoechst plant protection products have been discontinued by mutual consent.

Factories for Whitstable

Kent County Council has given planning permission for a new industrial estate at Whitstable. About 22 acres will be available, with a frontage to the arterial road at Thanet Way, to take factories from about 200,000 sq. ft. to 5,000 sq. ft.

Whitstable was recently added to the list of places where government assistance is available under the Distribution of Industry (Industrial Finance) Act, 1958: and the Board of Trade is now ready, in approved cases, to issue industrial development certificates for the Whitstable estate.

Shell's new fertiliser plant

Shell Chemical Co.'s new fertiliser plant at Shell Haven, Stanford-le-Hope, Essex, was opened on May 22 by the Duke of Northumberland, Chairman of the Agricultural Research Council. The plant, which will cost over £6½ million, has a capacity of 75,000 tons of ammonia a year. Later this year, when all units are complete, the nitrogenous fertiliser *Nitra-Shell* hitherto imported from associates in Holland, will be available for the U.K. market. *Nitra-Shell* is a granular nitrogenous fertiliser with a guaranteed nitrogen content of 23% and 31% carbonate of lime, which makes it the most concentrated nitrogenous granular fertiliser available in this country.

In his speech the Duke of Northumberland emphasised the rise in farm output which has taken place in recent years and the important part which fertilisers have played in this expansion. The Agricultural Research Council, he said, was conscious of the valuable contribution being made by commercial enterprise and welcomed every opportunity for collaboration between state-financed research centres and those of private enterprise.

After stressing the importance of our grasslands, the Duke welcomed the fact that Shell Chemical Co. were going to sponsor a National Grassland Demonstration on June 8 and 9, 1960, to be opened by Lord Netherthorpe, President of the N.F.U.

The Duke's address was preceded by that of Mr. F. A. C. Guepin, chairman of Shell Chemical Co. and a managing director of the Royal Dutch Shell Group, who pointed out that the present population of the world would have been doubled by the year 2000—a fact which underlined the challenge to research and increased food production. Science and technology as applied to agriculture could do a great deal to fill the gap.

The new CCF granulation plant (right) and storage silo (left) at I.C.I.'s Billingham Division. Nearly 1 million tons of fertiliser are produced at Billingham annually.

Drawback on hydrocarbon oils

The treasury have made the Hydrocarbon Oil Duties (Drawback) (No. 1) Order, 1959, which provides for the allowance of drawback of customs or excise duty paid in respect of hydrocarbon oil used in the manufacture of Vitamin D3.

The Order came into operation on May 13 and has been published as Statutory Instrument 1959, No. 836.

Viomycin available

Viomycin P, a mixture of viomycin sulphate and viomycin pantothenate, which is reported to be less toxic than viomycin sulphate alone, is available from the Distillers Company (Biochemicals) Ltd. *Viomycin P* is indicated in circumstances when combinations of the established antituberculous agents cannot be used because of intolerance or bacterial resistance. It is issued in one-gramme vials containing 500,000 units (0·5 gm. base) viomycin pantothenate and 500,000 units (0·5 gm. base) viomycin sulphate. The cost of a box of 5 vials is £3 5s. 5d. Available to hospitals only.

Stainless Steel Plant Ltd. move into new works

Stainless Steel Plant Ltd. have recently transferred to their new extensive works at Dorset Avenue, Thornton Gate, Cleveleys, Lancs., and are now in full production. A single storey factory of approximately 26,000 sq. ft. is now available in which extra equipment has been installed allowing for the fabrication of heavy plate work.

Mr. S. R. James and Mr. E. W. Cork have been appointed to the board of directors in the capacities of sales director and works director respectively. Mr. James was formerly with Albright and Wilson Ltd. and Clarnico Ltd., and Mr. Cork was with Giusti Ltd., London.

Erection service

Q.V.F. Ltd. have developed an erection service for their industrial glassware. This is staffed by technicians who have received specialised training in the erection of the company's products, and is designed to complement the assistance which the company offer with design and erection methods.

Extension to Chelsea College

Extensions in the form of a four-storey block and a two-storey addition to existing buildings, giving an additional floor area of 17,913 sq. ft., were opened by the Rt. Hon. the Lord Adrian at Chelsea College of Science and Technology on April 28. The new buildings will be occupied by the Departments of Chemistry, Mathematics and Physics and the School of Art.

A student's common room is also provided.

Agents visit Billingham

More than 400 agricultural merchants from all parts of England and Wales visited the Billingham Division of Imperial Chemical Industries Ltd. on April 21. The visitors, I.C.I.'s fertiliser agents, were shown the progress I.C.I. has made in fertiliser manufacture at what is the Commonwealth's largest chemical works. Nearly 1 million tons of fertiliser are produced at Billingham each year.

On their tour they saw a new plant for making Concentrated Complete Fertiliser. This is the largest granular fertiliser plant in Great Britain and one of the largest of its kind in the world. The merchants also saw plants producing *Nitro-Chalk, Kaynitro* and sulphate of ammonia.

Sir Alexander Fleck, chairman of I.C.I., welcomed the guests at a luncheon.

Methyl acetamide available

British Celanese Ltd. have now extended the range of chemicals which they offer by including n-methyl acetamide at a minimum purity of 98·5%. This product has applications as a chemical intermediate, but it is of more particular interest in pharmaceuticals, *e.g.* as a solubilising agent for chloramphenicol.

Enquiries should be addressed to British Celanese Ltd., Chemical Sales Department, 345 Foleshill Road, Coventry.

B.C.P.M.A. officers

The Thirty-ninth Annual General Meeting was held in London on April 30, 1959.

The retiring chairman of the British Chemical Plant Manufacturers Association, Mr. H. W. Fender, vice-chairman and managing director of Prodorite Ltd., has been re-elected for a further year.

The following officers have been elected:

Vice-Chairmen:

Mr. N. C. Fraser (W. J. Fraser and Co. Ltd.)

Dr. R. Lessing, C.B.E. (The Hydronyl Syndicate Ltd.).

Mr. P. W. Seligman (The A.P.V. Co. Ltd.).

Hon. Treasurer:

Mr. M. H. Wyndham (Bennett, Sons and Shears Ltd.).

Standards for essential oils

Following the publication some 11 months ago of a group of 15 British Standards for essential oils, B.S.I. has now issued in one volume, as B.S. 2999/16-31, standards for a further series of 16 distilled oils. These are as follows:

B.S. 2999/16, Oil of bay
" /17, Oil of cassia
" /18, Oil of Ceylon citronella
" /19, Oil of Java citronella
" /20, Oil of clove bud
" /21, Oil of clove leaf
" /22, Oil of clove stem
" /23, Oil of *Eucalyptus citriodora*
" /24, Oil of geranium, Kenya
" /25, Oil of geranium, North Africa
" /26, Oil of geranium, Réunion
" /27, Oil of petitgrain, Paraguay
" /28, Oil of pimento berry
" /29, Oil of pimento leaf
" /30, Oil of East Indian sandalwood
" /31, Oil of West Australian sandalwood.

Copies of this standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1. Price 8s. 6d.

Technical Press Review—June

Chemical and Process Engineering. —Plant Design Considerations in Effluent Treatment; Treatment of Wastes in the Chemical and Allied Industries; Automatic Control of Effluent Neutralisation; *p*H Neutralisation Plant for Trade Effluents; Fractional Distillation; Distillation Research—What is Needed; Review of Corrosion Exhibition.

Corrosion Technology.—Platinum Plating of Zirconium; High Impact PVC; Unplasticised PVC for Piping; Elastomers Research—Du Pont's New Laboratory; Thermoplastic Pipes and Fittings in the Dyeing and Finishing Industry; Corrosion of Aluminium and Its Alloys.

Automation Progress. — Moisture Measurement and Automatic Control; Bank Automation in the U.S.A.; Data Logging in Chemical Plant; Bank Automation in Britain.

Petroleum. — Gas Separation in Gasoline Processing—Russian Experiences; Electronic Instrumentation at Regent's Port Credit Refinery; Engineering Computer Control Systems; Pipeline Control Systems; Oilfield Development; Well Logging; Instrumentation in the Petroleum Industry.

Paint Manufacture. — Oil and Colour Chemists' Association's Biennial Conference; Colloid Mills for Paint Manufacture; Mechanical Handling Can Cut Costs; Review of Plant and Equipment.

Atomic World. — The Impact of Atomic Energy on Analytical Chemistry; Radiation and Agriculture; Reactors for Schools; Radiochemical Analysis for Nonactive Gases; Nuclear Energy in Norway; Supplement; Opening of Chapelcross Nuclear Power Station.

Food Manufacture. — Consultants —Their Role in Industry; Dairy Products; Milk Puddings; Pumps and Pipelines.

Dairy Engineering.—Bulk Handling Development in Scotland; Education for Dairy Management; American Studies in Dairy Management; The Literature of Dairying; Dairy Engineering Development in Eastern Europe—2.

World Crops.—Man-made Rain; Money from Muck; Water for Irrigation; The Cultivation of Citrus.

For specimen copies and subscription forms apply to the Circulation Manager, Leonard Hill House, Eden Street, London, N.W.1.

Insecticide by air

A cargo of concentrated insecticide, specially formulated for the Government of Jordan by the Standardised Disinfectants Co. Ltd., was flown out from London Airport recently. The order, which was said to be of considerable value, was confirmed on a Friday morning and the product manufactured and despatched on the following Tuesday.

Reed's new factory

Reed Corrugated Cases Ltd. is taking over a factory at Goose Green, Wigan, from British Celanese. The new branch will be self-contained, with its own sales, design and transport departments. An 85 in. Langston board making machine is being installed and production is expected to start early this summer. A staff of 350 is envisaged by the end of the year which, by the winter of 1960, will have increased to 750-800.

The factory was recently the subject of an interview filmed for B.B.C. television, when Mr. Aidan Crawley, the commentator, discussed the £1m. venture with Mr. T. C. Watkins, director and general manager of the company.

Para-xylene for Germany

The Heavy Organic Chemicals Division of Imperial Chemical Industries Ltd. recently received an order for several hundred tons of para-xylene, used in the manufacture of *Terylene*, from Farbwerke Hoechst of Frankfurt-am-Main, who produce a fibre of this type in Germany.

Para-xylene for export to Europe has previously been transported in rail tank waggons, but, in view of the size of this order, water-borne shipment in bulk from Tees-side to Frankfurt was considered advantageous for both I.C.I. and the customer. The ship selected, the Dutch m.t.v. *Cornelius B*, has tanks fitted with coils for the continuous circulation of steam, so that the para-xylene, which solidifies at temperatures below approximately 13°C., remained in a liquid state throughout the voyage.

Transport from Wilton to the Tees Conservancy Commission's wharf at Teesport was effected in a fleet of six insulated road tankers with stainless steel, single compartment tanks. A special manifold was erected at Teesport to enable four of these tankers to discharge into the ship's tanks at the same time, allowing a continuous shuttle service to operate between Wilton and Teesport.

Transhipment was arranged at Dordrecht in Holland to a Rhine barge designed for this type of cargo. A representative from H.O.C. Division Technical Service and Development Department was present at Dordrecht to supervise the transhipment.

Sir Owen Wansbrough-Jones (second from right) talks to K. L. Whitehead, Manager of *Corrosion Technology*, on the Leonard Hill Technical Group stand at the Corrosion Exhibition. The others in the picture are (from left to right) Mr. W. Leonard Hill, R. G. Paterson (Editor of *Corrosion Technology*), and on the extreme right, Ernest Hill, Manager of *Chemical and Process Engineering*.

Second Corrosion Exhibition attracted world-wide interest

Corrosion Technology's second Corrosion Exhibition, held in London's New Horticultural Hall from April 27-30 was 50% larger than the first held in 1957, and attracted over 11,000 visitors, many from overseas.

Exhibitors and visitors alike agreed that the exhibition was highly successful, and a number of new products were displayed for the first time.

The Exhibition was opened by Sir Owen Wansbrough-Jones, K.B.E., C.B., Chief Scientist of the Ministry of Supply, who in his opening address said that although the cost of corrosion to the world and to individual countries was very difficult to assess, a figure for this country equivalent to 2s. in the £ on the standard rate of income tax had been widely quoted. In this country we have a hideous moist climate, an extensive coastline and still regrettably a great deal of atmospheric pollution. He wondered whether the most significant aspect of corrosion was not more subtle than the direct monetary loss; more important might be losses in reliability, extra costs in maintenance, extra wear in mechanical equipment and so on. It is these aspects of corrosion, said Sir Owen, that the scientist can next tackle best.

He concluded by saying that a world without corrosion was not only unthinkable but even in the distant future might benefit from the encouragement of controllable corrosion, and he could foresee the possibility in the end of some calculated use of controlled corrosion.

Beecham's new factory

The Beecham Group Ltd. is to begin work shortly on the construction of a new factory at Worthing as one of the first steps towards expansion into the field of antibiotics. The Group's existing range of fine chemicals will be made here and, among other products derived from the work of Beecham Research Laboratories, the new penicillins likely to be evolved following the recent isolation of the basic penicillin molecule.

Beecham Research Laboratories Ltd. is to be formed into an operating division of the Group. It will incorporate C. L. Bencard Ltd. which currently markets the group's pharmaceutical products. This arrangement will bring together, in one company, the responsibility for research, development, manufacture and marketing of all the group's ethical pharmaceutical products. General pharmaceutical production, the Bencard allergy clinic, and the administrative headquarters of Beecham Research Laboratories Ltd. will be grouped in the building now occupied by Macleans Ltd. at Brentford.

To facilitate these moves, the present responsibilities of Macleans Ltd. for the marketing of proprietary medicines and toiletries will be divided respectively between Beecham Pharmaceuticals Ltd. and County Laboratories Ltd.

Annual dinner

The annual dinner of the Royal Institute of Chemistry was held at the Free Trade Hall, Manchester, recently. Guests were received by the Chairman and past-president, Dr. D. W. Kent-Jones.

Officers elected

The following Officers will serve the Industrial Pest Control Association for the year 1959-60: President: Mr. D. J. S. Hartt, May and Baker Ltd. Vice-President: Mr. G. A. Campbell, the Geigy Co. Ltd.; Honorary Treasurer: Mr. S. Farrow, London Fumigation Co. Ltd., and Secretary, Mr. W. A. Williams.

Diamond jubilee

Bruce Starke and Co. Ltd., essential oils merchants, celebrate their sixtieth anniversary this year. Mr. A. Bruce Starke, governing director, who founded the company in 1899, is still actively interested in the company.

Petroleum chemicals expansion

Sales of petroleum chemicals from the British Petroleum Group were satisfactory last year, despite increased competition in the industry During the last quarter of 1958 sales were at the rate of 195,000 tons p.a.

Work started last autumn on the third cracker for British Hydrocarbon Chemicals Ltd. at Grangemouth. This unit, when completed in mid-1960, will have an ethylene production capacity of 70,000 tons p.a., the largest such unit outside the U.S.A. The polyethylene plant for the manufacture of a new high density polyethylene, sold under the trade name *Rigidex*, is now being commissioned, and plants to make phenol and acetone are due to come into operation this year.

Drugs and medicines exempt from tax

The Treasury have made an Order under the Finance Act, 1948, Section 21, entitled "The Purchase Tax (No. 2) Order, 1959 (Statutory Instruments 1959, No. 809)." The Order extends the schedule of essential drugs and medicines exempt from purchase tax under the Purchase Tax (No. 3) Order 1958 which is revoked.

New items exempt from tax and extensions of existing items (in italics) are as follows:

HEAD I:

Any one of the following substances, prepared for use by injection:
Antihæmophilic globulin of human or animal origin.

HEAD II:

Benzyldimethyl-2-phenoxyethylammonium 2 : 2′-dihydroxy-1 : 1′-dinaphthylmethane-3 : 3′-dicarboxylate, *bephenium hydroxynaphthoate and mixtures of these substances*;
5-Chloro-2-(p-diethylaminoethoxyphenyl)benzothiazole, and salts thereof;
Chlorothiazide *and other derivatives of 7-sulphamoylbenzo*1 : 2 : *4-thiadiazine* 1 : 1-*dioxide*;
1-o-Chlorphenyl-3-dimethylamino-1-phenylpropan-1-ol hydrochloride;
Chlorpropamide;
1-Dehydro-17-alpha-methyltestosterone;
Dequalinium *salts*;
alpha-2-Diethylaminoethyl-alpha-phenylglutarimide, and salts thereof;
Dihydroxyaluminium sodium carbonate, whether or not mixed with calcium carbonate and *polyhydroxyaluminium sodium carbonate complexes, whether or not so mixed*;
Ditophal;
17-alpha-Methylandrost-5-en-3-beta : 17-beta-diol;
Stilbœstrol with either *streptomycin and polymixin B*, or organo-mercury compounds prepared for veterinary use.

HEAD III:

Chlorproguanil, and salts thereof;
7-(2-Hydroxypropyl)theophylline;
meso-Inositol hexanicotinate;
1 O-Methoxydeserpidine;
Pipamazine, and salts thereof;
Vitamins, vitamin complexes and provitamins, whether or not combined with one or more of the following substances, that is to say, iodine, sodium chloride, and *oxides, hydroxides and* salts of any metal other than sodium;
The following substances, and salts and derivatives thereof:
Isothipendyl.

The entry for Bemegride, and its sodium derivatives is transferred from Head II to Head III.

All drugs and medicines previously exempt under the revoked Order remain exempt under the new Order but certain of the drugs now appear under the name approved by the British Pharmacopœia Commission.

The order applies to goods which are despatched on sale by registered traders to unregistered traders or appropriated to retail trade or similar purposes by a registered trader and to imported goods entered with the Customs or delivered from bonded warehouse for home use.

New premises

The Reddish Chemical Co. Ltd., makers of detergents for the dairy, brewery and industrial fields, have moved to the Globe Works, Stanley Road, Cheadle Hulme, near Stockport, Cheshire. Tel. No. Hulme Hall 4406.

Wellcome research costs £1 m. annually

Speaking at the opening of the new laboratories of the Biological Division of the Wellcome Research Laboratories, Mr. M. W. Perrin, chairman of the Wellcome Foundation, said the company was spending over £1 million yearly in research and development. This was a partial cause and consequence of the capital investment of £2 million in new buildings at Beckenham (see MANUFACTURING CHEMIST, May, p. 148), but the company's research effort was not confined to the United Kingdom. About half the total research budget was spent by Burroughs Wellcome and Co. (U.S.A.) Inc.

The expenditure of £1 million annually was large in relation to the total research effort of the British pharmaceutical industry, he said, but was still very small in comparison with the sums spent by the giants in the U.S.A. and elsewhere, nor was a large expenditure on research itself any guarantee of success. Indeed, there could be no quicker way of wasting money unless research was directed along the right paths by men with wisdom—and luck.

In this field, Burroughs Wellcome had the special advantage of its unusual relationship with its shareholders, the five trustees of Sir Henry Wellcome's will under the chairmanship of Sir Henry Dale, himself once a member of the Wellcome Research team.

Officers elected

At the annual general meeting of the British Rubber and Resin Adhesive Manufacturers' Association held on May 5, Mr. D. E. Cameron, B.B. Chemical Co. Ltd., was re-elected chairman and Mr. N. G. Basset Smith, Dunlop Rubber Co. Ltd., was re-elected vice-chairman for 1959-60.

Sales conference

A two-day sales conference at the Waldorf Hotel, London, was held on April 30 and May 1 by J. C. and J. Field Ltd. (Fields of Bond Street), which is now a subsidiary of E. Griffiths Hughes Ltd., the Manchester firm of manufacturing chemists. It was attended by 36 representatives from all parts of the United Kingdom.

Company finance

Group profit after taxation of **F. W. Berk and Co. Ltd.** for the year ended December 31, 1958, amounted to £190,344 (£149,371). A final dividend of 4½d. per share, less tax, was recommended, making with the interim dividend of 1½d. per share, less tax, a total of 6d. per share, less tax, for the year.

Evans Medical Supplies Ltd. showed a consolidated net profit for the year ended December 31, 1958, after tax, of £188,768 (£158,878). A final ordinary dividend of 5d. per 5s. stock unit is proposed. It is proposed to shorten the company's name to "Evans Medical Ltd."

K. W. Chemicals Ltd. have increased their capital as follows: nominal, £50,000; fully paid-up, £25,000.

Turnover and profits of **Albright and Wilson Ltd.** for 1958 were the highest recorded. Profit before tax was £5,388,000 (£4,754,000). Dividend declared on the ordinary stock for the year ended December 31, 1958, amounts to 17% (16%), with £1,071,000 (£968,000) retained in the business.

MEETINGS

Society of Chemical Industry

PESTICIDES GROUP

June 26. Summer visit. Woodstock Agricultural Research Centre, Sittingbourne, Kent.

Royal Institute of Chemistry

June 25. Visit to Glaxo Laboratories Ltd.

June 29. Visit to Plastics Division, Imperial Chemical Industries Ltd.

July 1. Visit to Warren Spring Laboratory, Stevenage.

July 7. Visit to the Radiochemical Centre, Amersham.

Society for Analytical Chemistry

SCOTTISH SECTION

June 26. Joint meeting with the Polarographic Society. "Polarographic Investigation of some Copper Complexes in Non-aqueous Solution," by Dr. Z. Zigorski; "Polarographic Behaviour of Rhenium and Technetium," by Dr. R. J. Magee; "Application of Polarography to Tissue Respiration," by Dr. I. S. Longmuir; "Potentiometric Method for Acid-base Titration in Certain Acetone-water Solutions," by G. F. Reynolds; "Polarographic Determination of Nitroglycerine," by A. F. Williams; "Polarography in Fused Salts," by R. L. Faircloth. 10 a.m. Department of Chemistry lecture theatre, Queen's University, Belfast.

People

R. E. Huffam, who has been a director of Unilever Ltd. since 1941, and Unilever N.V. since 1945, has resigned both these appointments on reaching retirement age. He has joined the board of A. Boake Roberts and Co. (Holding) Ltd.

Herbert P. Nack has been appointed general manager of the Colgate-Palmolive Co.'s newly-created Drug Division. He joins the company directly from Johnson and Johnson, where he was director of the professional products Division and consultant to the president and the executive committee on matters pertaining to the drug industry.

Prior to his connection with Johnson and Johnson, Mr. Nack was, for two years, director of sales for the William S. Merrill Co. a division of Vick Chemical Co., and general manager of their Canadian company.

J. C. Marshall, B.SC., has been appointed to the newly created post of southern district manager of Union Carbide Ltd., Chemicals Division. In this capacity he will be directly responsible for all chemical marketing activities for the whole of the South of England, including the South and West Midlands. All the technical representatives now covering these areas will be responsible to Mr. Marshall in his new capacity.

Dr. D. A. Long, M.D.(LOND.), has been appointed chief medical adviser and head of the medical research department of the Wellcome Foundation Ltd. Dr. Long has been a member of the National Institute for Medical Research since 1948. He held previous appointments at St. Bartholomew's Hospital Medical School and at the London School of Hygiene and Tropical Medicine. In 1957-58 Dr. Long was Visiting Professor in Microbiology in the School of Medicine at the University of Pittsburg, U.S.A.

C. L. Boltz, B.SC., has been appointed Science Correspondent in the B.B.C. News Division (sound and television). This is the first appointment of its kind in Britain. Mr. Boltz has been Science Correspondent of the B.B.C. European Service since 1952 and he has made many hundreds of broadcasts on all aspects of British science and industry. A Somerset man, he graduated in physics at London University and has done research on electron theory. He has published papers in several learned journals and has written many popular books on science. His book "Wireless for Beginners" has sold over 50,000 copies.

E. D. Carey

At its annual meeting on April 30, the Council of he Association of British Pharmaceutical Industry elected **E. D. Carey**, managing director of Imperial Chemical Industries Ltd. (Pharmaceuticals Division) president for the year 1959-60. **H. W. Palmer**, managing director of Glaxo Laboratories Ltd., was elected vice-president. **G. T. Morson,** M.C., was re-elected honorary treasurer.

Frank Chapman, M.A., has been appointed managing director of Carnegies of Welwyn Ltd., which company was recently acquired by Rexall Drug Co. Ltd.

K. Strebel, ING.CH., has joined the board of directors of Arthol Ltd. He has had wide experience in aromatics, perfumery and cosmetics.

N. J. Butler, M.SC.(N.Z.), M.I.BIOL., has been made a partner in the consulting practice of Galloway and Barton-Wright, industrial microbiologists and biochemists.

Morgan and Co., civil, industrial and management consulting engineers, have appointed **H. W. Dowe,** A.M.I.STRUCT.E., as chief engineer of their Leeds office, at 31A-33 York Place, Leeds 1.

L. Coombs has been appointed associate director (home operations). His previous appointments with the company include that of supply manager and home sales manager. He is 38 years of age and has been with the company for five years.

R. B. Seymour has been appointed associate director (manufacturing) of Aspro-Nicholas Ltd. He has been promoted from Production manager, a post which he held for 12 months following three years' service as technical manager. Mr. Seymour, who is 34, holds an Honours diploma in chemical engineering (Loughborough College) and is Associate Member of the Institute of Chemical Engineering.

News from Abroad

UNITED STATES

Tartar chemicals to be made in Europe

Stauffer Chemical Co., which has been a major U.S. producer of tartar products for 60 years, was forced to shut down its tartaric acid, cream of tartar and tartrates plant recently owing to the pressure of imports and the unfavourable tariff situation.

Now the company has arranged to have tartar products manufactured to its specifications in Europe. Output of the firms with which Stauffer has contracted will include all the grades of tartar chemicals which the company previously made in its Brooklyn plant.

Colgate to make pharmaceuticals

The Colgate-Palmolive Co. has entered the proprietary and ethical drug fields, with the establishment of a new division within the company's organisation, to be known as the Drug Division.

In making this announcement, Mr. E. H. Little, president of the company, termed the development as, "an important step being taken by the company, that can contribute to our diversification and to our continued growth and progress. With our domestic and world-wide marketing facilities," he said, "and with the great growth and potential that is evident in the drug market, we feel that we are making a move which can prove very worthwhile to the company."

HONG KONG

New pharmaceutical factory

Dr. the Hon. Chau Sik Nin, C.B.E., a member of the Executive and Legislative Councils in Hong Kong, opened a newly built pharmaceutical plant in the Colony on May 7.

The factory, which is at Aberdeen on Hong Kong island, has been established by Antibiotics Ltd. for the manufacture of antibiotics and as a distribution centre for other pharmaceutical products.

It is completely air-conditioned and bacteriologically sterile. It provides 32,000 sq. ft. of factory area and will give employment to upwards of 300 Hong Kong people.

AUSTRALIA

Distribution centre

Drug Houses of Australia (Queensland) Pty. Ltd. are building a £500,000 drug distribution centre in Brisbane. Expected to be completed before next Christmas, the building will cover a floor area of 100,000 sq. ft. and be wholly air-conditioned. It has been designed to allow straight line production.

SOUTH AFRICA

Vaccine for colds

A South African vaccine to prevent common colds has been tested successfully, it is claimed, by a Johannesburg doctor. It is said to have been effective in 85% of the human "guinea pigs" who underwent the trial. In *Medical Proceedings*, the doctor describes how he selected 103 volunteers from the Electricity Department of the Johannesburg Municipality. In April, last year, he gave each of them 24 vaccine tablets. He then interviewed them in November.

He found that 16 people (15·5%) had not benefited from the treatment. None of them, however, had more frequent or more severe colds than before. All the others (84·5%) said that the immunisation had undoubtedly helped them. Of these, 43 said that they had had no colds during the winter, and 37 that their colds were milder than in previous years. To establish whether the benefit from the vaccine was real or only apparent, the doctor interviewed 50 other employees who received no vaccine. He found that only seven (14%) had fewer colds than in previous years. Six (12%) had more frequent and more severe colds than before, while 37 had about the same number of colds and as severely as in past years.

The doctor concludes, "there was undoubted benefit in 84·5% of the cases." The vaccine used was developed in a South African laboratory, and is made from various bacteria which give immunity against colds by stimulating the production of antibodies. The vaccine is administered as tablets, or as drops. A course of treatment cost £1 1s. for drops or 30s. for tablets.

Aluminium sulphate plant

African Explosives and Chemical Industries (Rhodesia) Ltd. are to spend about £85,000 on new plant in their Salisbury factory for the production of aluminium sulphate to be used for the purification of water. This will be supplied to municipalities and to the mining companies which operate their own water purification plants.

Pharmaceutical firms re-organised

Standard Finance Ltd., formerly known as Standard Canners and Packers Ltd., through its subsidiary South African Druggists Ltd., controls with S. A. Druggists four of the South African pharmaceutical firms, MacDonald Adams and Co. Ltd., Lennon Ltd., B. Owen Ltd. and Heynes Mathew Ltd. This arrangement is the culmination of a long period of negotiation, and the firms have now been reorganised under the lead of South African Druggists so that overlapping and unnecessary competition is eliminated.

Under the new arrangement, B. Owen Jones Ltd. have incorporated MacDonald Adams and Co. Ltd., and the combined companies now deal in laboratory equipment and apparatus, industrial, scientific and laboratory instruments, industrial and reagent chemicals, fertiliser chemicals and water treatment preparations. Heynes Mathew and South African Druggists are responsible for the supply of a wide range of pharmaceuticals, together with photographic equipment and optical requirements. Lennon's will now largely be responsible for the manufacturing sections of the allied trades and industries.

The organisation has a large factory in Observatory, Cape Town, which is the headquarters of the group, which, however, has branches and agencies in all the main centres of the Union and the Federation of Rhodesia and Nyasaland. The resources, technical services and marketing operations of all the companies have now been closely co-ordinated.

BRAZIL

Capital increased

The West German firm of Chemische Werke Huels A.G., Marl, have raised the capital of their subsidiary in São Paulo, Quimica Industrial Heuls do Brasil Ltda., Avenida Ipiranga 103-6° andar, from Cr$ 2.5 to Cr$ 125 million.

The Companhia Quimica Rhodia Brasileira, Rua Libero Badaro 119-5° andar, São Paulo, has also raised its capital from Cr$ 1,340 to Cr$ 1,490 million largely by payment from the parent firm, Société des Usines Chimiques Rhône-Poulenc, Paris. The "Rhodia Brasileira" produces a wide range of chemical products, including pharmaceuticals, industrial acids, and plastics.

HUNGARY

A safer chemical industry

Working conditions in the chemical industry have been considerably improved, Mr. Sándor Czottner, Minister of Heavy Industry, told a recent conference on industrial safety. Despite a 20% increase in the number of workers, accidents in the industry dropped by 10% last year. More than £1,100,000 was spent by the Ministry last year on safety installations and protective clothing and £360,000 went to provide protective food and drinks for workers in the industry.

Hours of many workers are being cut. Last year working time was reduced for 3,500 workers and this year 4,000 are to go on to a 40-hr. week

And under the second five-year plan, said Mr. Czottner, spending on industrial safety is to increase tenfold.

INDIA

New dyestuffs plant

Situated on the outskirts of Bombay, a new dyestuffs plant for Hickson and Dadajee Private Ltd. was opened on May 2. The principal speaker at the opening ceremony was Mr. S. J. Wankhede, Minister of Planning, Development and Industries.

The plant has gone into production less than a year after the commencement of the development of the site. It has ample room for further expansion and for the production of a large range of intermediate chemicals. Initially sulphur black and *Photine* optical whitening agents will be made, but a licence has been obtained from the Indian Government for the manufacture of 21 intermediates for dyestuffs, paints and pharmaceuticals.

British visitors attending the ceremony were Mr. Bernard Hickson, chairman, and Mr. G. K. Day, joint managing director of Hickson and Welch Ltd. Hickson and Dadajee Private Ltd. was incorporated in 1953 by Hickson and Welch Ltd., Castleford, Yorkshire, and Dadajee Dhackjee and Co. Private Ltd., Bombay. In June 1954 a temporary plant was erected in a leased factory at Sewree, it commenced the manufacture of sulphur black a year later.

First polythene plant

India's first full-scale polythene plant was opened on May 2 at Rishra, near Calcutta, by Mr. Morarji Desai, the Indian Minister for Finance. It has been built by the Alkali and Chemical Corporation of India, a subsidiary company of I.C.I. (India) Private Ltd. Including houses, roads and services, the project has cost approximately £3 million.

The new plant has a capacity of 3,500 tons of *Alkathene*, the I.C.I. brand of polythene, which it will produce by the high-pressure process discovered and developed by I.C.I. It is expected to save India over £1 million a year in foreign exchange, for until now all the polythene used in India has been imported. Demand for polythene is increasing rapidly in India. In 1952, when I.C.I. (India) began to make *Alkathene* film from imported raw material, total Indian consumption was only 100 tons. In 1958 the figure was 2,100 tons.

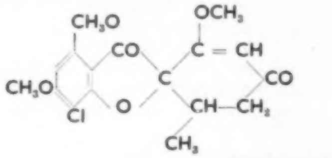
The main raw material for the new plant is ethyl alcohol, produced by distilleries from molasses. The alcohol is dehydrated in a converter to produce ethylene, and this gas is purified before being compressed and polymerised. Indian chemists, chemical engineers and engineers have been trained in Britain and Australia to take their part in running the plant. Technical experts from I.C.I. Plastics Division have been in India since February to assist in the commissioning of the plant.

New Products

Oral treatment for ringworm

Large-scale production of the antibiotic griseofulvin, recently found to be effective in the treatment of ringworm and other fungoid diseases, has begun at the Glaxo deep fermentation plant at Ulverston. The drug is of unusual interest in that it is taken by mouth instead of being applied externally as is the case with most treatments for fungal conditions. The company is to market the drug under the name of *Grisovin*.

Many of the fungi responsible for skin infections in man are extremely difficult to eradicate. The dermatophytes living in the keratin of the skin, hair and nails, which they digest by enzyme action, are usually inaccessible to topically applied fungicides. On this account, the ideal treatment has been postulated as one that could be administered internally so that it might exert its action from within outwards. By this means, new keratin resistant to fungal penetration could be produced. Griseofulvin appears to achieve this theoretically desirable objective, and to be taken up by the cells destined to produce keratin. It is a colourless neutral substance only sparingly soluble in water. It is stable to heat and also in water, and has the following chemical structure:



Griseofulvin

7-Chloro-4:6-dimethoxycoumaran-3-one-2-*spiro*-1′-(2′-methoxy-6′-methyl*cyclo*hex-2′-en-4′one)

In general, the level of dosage that has been found effective is about 15 to 25 m.g. griseofulvin per kilogram body-weight daily by mouth. For practical purposes, the dosage given to adults is 1 g. of griseofulvin (four *Grisovin* tablets) daily by mouth. In the more severe or extensive cases, up to 2 g. daily may be given to adults at the beginning of treatment, reducing to 1 g. when clinical response has occurred. For convenience the daily dosage may be subdivided if desired.

For children, doses of 250 to 500 mg. (one to two *Grisovin* tablets) daily are used, but as much as 1 g. daily has been given without side effects.

Side effects so far reported have been transient, and minor in character. Occasional complaints of headache or gastric discomfort have been noted, and urticarial reaction or erythematous rash has occurred on rare occasions. In most cases, these symptoms have disappeared during treatment; in others, reduction of dosage or termination of treatment have resulted in the disappearance of all undesirable effects.

The pilot plant at Glaxo's Fermentation Research Division at Sefton Park, Stoke Poges, near Slough, during research into Grisovin production

Grisovin tablets contain 250 mg. griseofulvin in each, and are issued in bottles of 100 and 1,000. A course of tablets for the treatment of ringworm or one of the other fungal diseases would probably take up to four weeks. Cost to the N.H.S. would be in the region of £3 15s.

The incidence of serious fungoid infection is especially high in tropical and subtropical countries. It is expected that there will be a substantial potential for the product in India, Asia, the Far East and the Americas.

Budgerigar tonic

A tonic for budgerigars has been introduced by Boots in their *Scamp* range for pets.

Although this range was originally limited to the care of cats and dogs, the tremendous increase of Britain's cage bird population over the past three years, bringing the country's feathered pets to over 10 million, compared with approximately 5 million dogs and 3,500,00 cats, has produced considerable demand for a reliable tonic of this type.

The product is based on calcium, phosphorus, iron, iodine and manganese, and contains hypophosphites.

Claims based on reports from fanciers, together with results obtained by the company, indicate that the tonic improves general health, plumage, fertility, and helps the birds through their moult quicker. The "Budgie Tonic" costs 2s. a bottle.

New deodorant

The Bristol-Myers Co. Ltd. have developed a new, lightly perfumed body spray deodorant called *Mum Mist Body Spray*. It is packed in a pale pink plastic bottle with a black cap and gold neck label. A matching display outer in white, pink and black carries the same colour theme. Each outer holds six individual bottles.

It is claimed that the deodorant is not limited as an underarm deodorant. It can be sprayed under arms, on feet, hands, back, or as an all-over body deodorant. Retail price is 3s. 6d. per bottle.

Tablet tests for feed water

Simplicity is a feature of tablet tests devised by Dr. A. T. Palin for control of water treatment. The following range is now available from Wilkinson and Simpson Ltd.: Residual chlorine (DPD and ortho-tolidine methods), *p*H (free from chlorine interference), alkalinity M, alkalinity P, alkalinity P ($BaCl_2$), chlorides, EDTA methods for total hardness, calcium hardness and sulphates.

Residual chlorine and *p*H tablets are used with Lovibond Comparators and Nesslerisers. In other tests the results are obtained quite simply by counting the tablets required to give a distinct colour change in the sample. The aim has been to combine all reagents for a given test in a single tablet so that the operator is able to obtain results of adequate accuracy using no more than a bottle for the water sample and a bottle of the appropriate tablets.

THE CHEMICAL MARKET

MARKET STEADY : PRICES STABLE

LONDON.—Prices this month have been steady, apart from **refined deodorised palm kernel oil,** which has increased by £6 to £161 per ton in 2-ton lots, and **refined, deodorised palm oil,** which has increased by £3 to £117 per ton in 2-ton lots. **Naphthalene.** both crystal and ball has decreased by £6 5s. 3d. to £58 19s. and £67 9s. per ton in 5-ton lots respectively. The prices of methylated spirits and acetone have not increased, as stated last month, and the prices quoted below are those now current.

FINE CHEMICALS

Acetanilide 12½ kg. 7s. 4d. kg.
Arsenious oxide B.P.
7-lb. lots 1s. 9d. lb.
1-cwt. lots 1s. 2d. lb.
Ascorbic acid
100 kg. £4 14s. kg.
Aspirin
56 lb. 5s. 2d. lb.
1-cwt. 4s. 11d. „
5-cwt. lots 4s. 9d. „
Atropine
Sulphate, 500 g. £59 18s. 6d. kg.
Alkaloid, 500 g. £69 10s. kg.
Benzene B.P.C. 28-lb. lots 1s. 8d. lb.
Benzoic acid 12½ kg. 7s. 4d. kg.
Benzyl benzoate
According to pack 5s. to 7s. 2d. lb.
Bismuth oxide B.P.C. 1934
28-lb. lots 26s. 10d. lb.
Bismuth salts 28-lb. lots:
Carbonate 22s. 3d. lb.
Subgallate 21s. 1d. „
Salicylate 21s. 9d. „
Subnitrate 20s. 5d. „
Borax B.P.
Powder £57 10s. ton
Extra fine £58 10s. „
Boric acid B.P.
Crystal £95 10s. „
Powder £93 „
Bromine B.P.C. 7-lb. lots 6s. lb.
Caffeine 50 kg. 42s. 6d. kg.
Calamine 50 kg. 4s. kg.
Calcium gluconate
1 cwt. lots dlvd. 3s. 7d. lb.
Calcium glycerophosphate
50 kg. 28s. 6d. kg.
Calcium lactate B.P.
7-lb. lots 2s. 11d. lb.
1-cwt. lots 2s. 4d. „
Chloral hydrate 50 kg. 10s. kg.
Citric acid, B.P. Powder or granulated:
1-cwt. lots £11 5s. cwt.
5-cwt. lots £11 „
Codeine
Alkaloid 100 g. £138 10s. kg.
Phosphate 100 g. £110 „
Cream of tartar
1-cwt. lots £11 15s. cwt.
5-cwt. lots £11 13s. „
Ephedrine
Hydrochloride 3 kg. £7 1s. 1d. kg.
Alkaloid 3 kg. £12 7s. kg.
Sulphate 3 kg. £7 1s. 1d. „
Eucalyptol
1-cwt. lots 11s. lb.
5-cwt. lots 10s. 6d. „
Ferri ammonium citrate B.P.
1-cwt. lots, scales 4s. 7d. lb.
1-cwt. lots, granules 3s. 9d. „
Ferrous gluconate
1-cwt. lots dlvd. 6s. 3d. lb.
Gallic acid B.P.C.
1-cwt. lots 10s. „
Gluconic acid technical 50%
Minimum 12-gal drums
19s. gal., drums extra, returnable
Glucono delta lactone
1-ton lots delvd. 5s. net lb.
Glycerophosphoric acid
24 litres 11s. 10d. litre
Glycine (amino acetic acid)
12½ kg. 18s. 10d. kg.
Hexyl resorcinol 10 kg. £7 10s. kg.
Hydroquinone 12½ kg. 23s. 10d. kg.
Iodides
Ethyl 4 kg. bottles 62s. 9d. kg.
Mercury, red B.P.C.
28-lb. lots 28s. 4d. lb.
Potassium B.P.
28-lb. lots 8s. 0d. „
Sodium B.P.
28-lb. lots 13s. „
Iodine, Chilean crude,
99% min. in wooden casks 15s. kg.
Iodoform
12½ kg. and under 50 kg. 42s. 6d. kg.
Lactose 50 kg. 3s. 2d. kg.
Lithium salts 5-cwt. lots
Benzoate 10s. lb.
Carbonate B.P.C. 11s. 3d. „
Chloride (commercial) powder
11s. „
„ granular 10s. 9d. „
Hydroxide 9s. 9d. „
Citrate B.P.C. 9s. „
Sulphate 8s. 6d. „
Salicylate, 10 cwt., dlvd. 9s. 9d. „
Magnesium carbonate B.P.
Light cwt. lots dlvd. £129 ton
Magnesium trisilicate 28-lb. packs
28-lb. lots 4s. 3d. lb.
1-cwt. lots 3s. 10d. „
5-cwt. lots 3s. 7d. „
Bulk rates for larger quantities are from 3s. 1d. lb. in 1-ton lots
Manganese hypophosphite B.P.C.
7-lb. lots 13s. 11d. lb.
1-cwt. lots 12s. 11d. „
Mercuric chloride B.P.
50-kg. lump 48s. 6d. kg.
Methyl salicylate 1-cwt. lots 3s. 3d. lb.
Morphine
Alkaloid, 100 g. £138 18s. 4d. kg.
Nicotinamide 1 kg. £3 5s. kg.
Nicotinic acid
12½ kg. 52s. 6d. kg.
1 kg. 55s. „
Oleine, B.P. extra pale, 3/4 cwt. drums returnable carriage paid G.B.
£160 ton
Phenolphthalein 50 kg. 24s. 3d. kg.
Phosphoric acid B.P.
(s.g. 1·750) 10-carboy lots 1s. 4d. lb.
Potassium permanganate B.P.
1-cwt. lots dlvd. 1s. 11¼d. lb.
Procaine hydrochloride (foreign) 2 kg.
59s. kg.
Quinine 1-oz. lots 4s. 4d. oz.
Riboflavin
100 g. 5½d. g.
10 g. 7d. „
Saccharin
500 g. £7 4s. for this quantity
Salicylic acid
B.P., dlvd. 3s. 2½d. to 5s. 6d. lb.
Silver nitrate
500 g. 5s. 1⅝d. oz.
Sodium benzoate B.P.
1-cwt. lots 2s. 9½d. lb.
1-ton lots 2s. 7½d. „
Sodium gluconate technical
8-cwt. lots delvd. 3s. net lb.
Sodium salicylate
50 kg. 8s. 8d. kg.
12½ kg. 9s. „
Sodium thiosulphate
Crystals, photographic quality
1-ton lots 49s. cwt.
Stearic acid B.P.C. flake, carriage paid G.B. £154 ton
Strychnine 25 oz.
Alkaloid 8s. oz.
Hydrochloride 8s. „
Sulphate 7s. „
Sulphaguanidine
12½ kg. 33s. kg.
50 kg. 32s. „
Sulphanilamide
12½ kg. 16s. 6d. kg.
50 kg. 15s. 4d. „
Sulphathiazole 12½ kg. 39s. 9d. kg.
Tannic acid B.P. Levis
1-cwt. lots 10s. lb.
Tartaric acid B.P.
Powder or granulated,
10 cwt. or more £14 10s. cwt.
Terpineol B.P.
40-gal. drums 2s. 4½d. lb.
1-cwt. lots 2s. 7d. „
Theophylline B.P.
500 g. 27s. 6d. for this quantity
Thiamine hydrochloride
100 g. 4d. g.
1 kg. £11 15s. kg.
Thioglycollate
Ammonium 12s. 4d. to 16s. 4d. lb.
Calcium:
7-lb. lots 17s. 3d. „
5-cwt. lots 14s. 3d. „
α-Tocopherol 25-g. lots 1s. 1d. g.
Vanillin 23s. 6d. to 30s. 6d. lb.
Zinc oxide B.P.
2-ton lots £109 ton

GENERAL CHEMICALS

Acetic acid 1-ton lots dlvd.
80% Technical £99 ton
80% Pure £105 „
Glacial B.P. £114 „
99-100% Glacial £111 „
98-100% Glacial £108 „

Acetic anhydride
1-ton lots dlvd. £128 ton

Acetone
5-gal. drums, free, non-returnable £128 ton
40 to 45-gal. drums, 10-ton lots £88 „

Alum, potassium granular crystals
50 kg. 1s. 2d. kg.

Aluminium hydroxide B.P.C. 34
28-lb. lots 2s. 4d. lb.

Aluminium stearate
(Precipitate) 1-ton lots £253 6s. ton

Ammonia
Persulphate £6 2s. 6d. cwt.
Phosphate: Mono- £106 ton
Di- £100 „

Amyl acetate
B.S.S. 10 tons and over £251 ton
Technical £249 „

Amyl alcohol
Technical in 1-ton lots £260 ton

Arsenic White powdered ex store £42 ton

n-Butyl acetate
10-ton lots £173 ton

n-Butyl alcohol
10-ton lots £149 ton

Calcium chloride
Solid 70 to 72%, 8-ton lots dlvd. £16 10s. ton

Calcium oxide (Lime)
Ex marble 28-lb. lots 3s. 10d. lb.

Caustic soda
Solid 1-ton lots, from £37 16s. 6d. ton

Chloroform B.P. ½-ton lots 2s. 11½d. lb.

Chromic acid
Dlvd. U.K. (less 2½%) 2s. 0¼d. to 2s. 0¾d. lb.

DDT 3s. 0½d. to 3s. 2d. lb.

2 : 4-Dichlorophenoxyacetic acid
99% pure, 1-cwt. bags £320 ton

Dimethyl sulphate 400 lb. drum lots 3s. 8d. lb.

Ether (Diethyl ether)
Tech. B.S.S. and Solvent B.P.
1-ton lots in drums 2s. lb.

Ethyl acetate 10-ton lots £145 ton

Ethyl alcohol
95% Gay Lussac 66·0 o.p.
2,500 to over 300,000 proof gallons per year in tank wagons
4s. 2¾d. to 4s. 0¼d. per proof gal.

Ferrous sulphate 50 kg. 1s. 4d. kg.

Formaldehyde
40% by volume dlvd. England 1-ton lots £38 15s. ton

Glycerin
1·2627 s.g. chem. pure, 5 tons and up, 5-cwt. drums £201 10s. ton
1·2627 s.g. technical grade, 5 tons and up, 5-cwt. drums £196 10s. ton

Hexamine
1-ton lots
Technical, bulk 1s. 8d. lb.
B.P.C. 1s. 11d. „

Hydrochloric acid
Commercial 18s. 6d. cwt.

Hydrogen peroxide
27·5% weight £119 ton
35% weight £143 „

Lactic acid (1-ton lots)
Pale tech. 44% by weight 1s. 3¼d. lb.
Dark tech. 44% by weight 9¼d. lb.

Magnesium chloride
Solid (ex wharf): 1-ton lots £17 10s. ton

Magnesium sulphate £15 ton

Mercurous chloride (calomel)
50 kg. 65s. kg.

Mercury sulphide, red
Ton lots and over 30s. 6d. lb.

Methylated spirits (Industrial)
Perfumery quality 500 gal. and upwards: gal.
61 o.p. 7s. 2½d.
74 o.p. 7s. 10d.
5 to 10 gal.:
61 o.p. 8s. 8d.
74 o.p. 9s. 3½d.

Methyl ethyl ketone
10 tons dlvd. in drums £143 ton

Methyl isobutyl carbinol
10 tons and up, in drums, dlvd. £163 ton

Methyl isobutyl ketone
10 to 50 tons, in drums, dlvd. £169 ton

Naphthalene
Crystal, dlvd., 5-ton lots, spot £58 19s. ton
Ball and flake (ditto) £67 9s. „

Nickel sulphate
dlvd. ton lots £189 ton

Nitric acid 70% intermediate £32 „

Pentachlorphenol
Flake, technical, 1-ton lots, dlvd. 2s. 2d. lb.

Phenol Crystals:
Under 1 ton dlvd. from 1s. 7d. lb.
10 tons and over dlvd. in returnable drums from 1s. 4½d. lb.

Phthalates
10-ton lots in drums
Diethyl (B.S.) £187 10s. ton
Dimethyl (B.S.) £179 ton

Potassium bromide
50 kg. 5s. 6d. kg.
12½ kg. 5s. 8d. „

Potassium carbonate
Calcined 96 to 98% (1-ton lots ex store) £76 ton
Hydrated (1-ton lots) £74 10s. „

Potassium fluoride
28-lb. lots 5s. 1d. lb.

Potassium sodium tartrate
5-cwt. lots £10 cwt.

Soda ash
1-ton lots dlvd., from £19 16s. 6d.

Sodium cyanide
96-98% £130 ton

Sodium hydroxide 28-lb. lots:
sticks (1-lb. bottles) 4s. 3d. lb.
pellets „ „ 3s. 9d. „

Sodium metal 28-lb. lots 3s. 8d. „

Sodium metasilicate
Dlvd. U.K. in ton lots £26 ton

Sodium phosphate
Dlvd. ton lots: Di-sodium, crystalline £40 10s. ton
Anhydrous £88 „
Tri-sodium, crystalline £39 „
Anhydrous £86 „

Sodium silicate
according to quantity, grade and delivery point
8-ton lots £13 10s. ton
1-ton lots £17 „

Sodium sulphate Ex works:
(Glauber salt) £13 ton
(Salt cake) unground, full truck loads £8 16s. 6d. ton

Sodium sulphide
Broken, returnable drums, dlvd. ton lots £37 2s. 6d. ton
Flake, ditto £38 12s. 6d. „
Solid ditto £36 2s. 6d. „

Sodium sulphite
Commercial crystals 4-ton lots £24 10s. „
(Dlvd. London in 1-cwt. single non-returnable bags)

Sodium tripolyphosphate
1-ton lots £95 ton

Stannic chloride 28-lb. lots 8s. 11d. lb.

Stannous chloride 28-lb. lots 9s. 5d. lb.

Strontium carbonate
96-98% 28-lb. lots 3s. lb.

Sulphuric acid, ex-works, according to quality and quantity
B.O.V. 78% from 8s. to 10s. cwt.
C.O.V. 96% from 11s. to 14s. cwt.

Zinc chloride
28-lb. lots sticks 6s. 9d. lb.

OILS AND FATS

Palm kernel oil
Refined, deodorised, 2-ton lots, naked, ex works £161 ton

Palm oil
Refined, deodorised, 2-ton lots, naked, ex works £117 ton

Stearine
dlvd. free bags
Pristerene 64 flake £148 ton
Pristerene 62 flake £133 „
Pristerene 61 flake £113 „
A premium of £2 ton is charged for powder and £4 for block

GUMS AND WAXES

Agar Agar No. 1
Kobe strip 13s. 6d. lb.
Powder 17s. 6d. „

Beeswax
Dar-es-Salaam spot (nominal) £26 cwt.
Sudan spot (duty paid) £24 „
Bleached white (slab) £30 „
Refined yellow (slab) £26 „

Benzoin
Sumatra spot £27 cwt.
Siam spot £2 7s. 6d. lb.

Candelilla Spot £23 cwt.

Carnauba
Prime, Spot £48 cwt.
Fatty grey £30 10s. „

Gum arabic Lump £8 10s. cwt.

Karaya Powder, Spot 3s. 8d. lb.

Paraffin wax
1-ton lots, acc. to grade £87 10s. to £120 ton

Peru balsam 11s. lb.

Shellac
No. 1 orange £13 cwt.
No. 2 orange £11 10s. „
Transparent white 4s. 3d. lb.
Pale dewaxed 6s. „

Tragacanth
No. 1 spot £127 10s. cwt.
No. 2 spot £121 „
Pale leaf £50 „
Amber £36 „
Brown to Red £27 „

NEW TRADE MARKS

APPLICATIONS

Pharmaceuticals

LEMCO.—715,534. *Oxo Ltd.*
ONIXOL.—B750,073. *The Scholl Mfg. Co. Ltd.*
PAXO.—764,861. *John Crampton and Co. Ltd.*
VITESULE.—774,654; VITASULE.—774,655. *Marfleet Refining Co. Ltd.*
MECORAL.—775,233. *Det Danske Medicinal- and Kemikalie Kompagni A/s.*
TUSSIONEX.—778,830. *R. J. Strasenburgh Co.*
SINOTABS.—779,638. *Optabs Ltd.*
ALLITRIN.—779,728. *Allied Laboratories Ltd.*
PETHIDEX.—781,322. *Clinical Products Ltd.*
NEMODON.—781,823. *Ward, Blenkinsop and Co. Ltd.*
MEZAPRIN. — 782,746. *Imperial Chemical Industries Ltd.*
TARUGAN. — 782,979; FILON. — 782,981. *Ravensberg G.m.b.H.*
TUSSNIP.—783,434. *A. H. Williams.*
ALNATEX.—775,542. *Modern Health Products Ltd.*
FEMANA.—778,418. *Cyril Lord Ltd.*
APTHINE.—778,525. *A.b. Astra, Apotekarnes Kemiska Fabriker.*
LUBRICIL.—780,317. *Imperial Chemical Industries Ltd.*
BIOBALM.—780,535. *Modern Health Products Ltd.*
LOMU.—781,443. *Benger Laboratories Ltd.*
RYNATAN.—783,173. *Irwin Neisler and Co.*
ROVIBE.—783,410. *Roche Products Ltd.*
SYMPATOVIT.—783,774. *C. H. Boehringer Sohn.*
DIMOTANE.—*A. H. Robins Co. Inc.*
BIOGERM.—B779,202. *Multiforsa Ltd. (Multoforsa S.a.).*
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CARBOSTESIN. — 782,848. *A/B Bofors.*
PRIMOGERON.—782,952. *Schering A.G.*
LUDOMIL.—777,522. *Ciba Ltd.*
BENTEN.—B779,679. *C. L. Bencard Ltd.*
LOMUDASE.—777,698; LOMUPREDNASE.—777,699; IMPODASE.—779,439; IMPATAX. — 779,438; IMPOTRIX.—779,440. *Benger Laboratories Ltd.*
HELMATAB.—778,629. *Gale, Baiss and Co. Ltd.*
ORABOLIN. — 779,929. *Organon Laboratories Ltd.*
CLEMACILLIN.—781,574. *The Distillers Co. (Biochemicals) Ltd.*
BONASPIN.—781,783. *Farbenfabriken Bayer A.G.*
AUTRIN.—782,825. *American Cyanamid Co.*
NESMIL. — 782,984; DIETON. — 783,370. *The Nestle Co. Ltd.*
DEQUALONE.—784,314. *Allen and Hanburys Ltd.*
DISAMIDE.—783,573. *British Drug House Ltd.*

NEW COMPANIES

These particulars of new companies have been extracted from the daily register of Jordan and Sons Ltd., company registration agents, Chancery Lane, London, W.C. 2.

Hampton-in-Arden Pharmacy Ltd. 5.3.59. Fentham Rd., Hampton-in-Arden, Solihull, Warwicks. £1,500. Dirs.: Miss P. T. Ward and T. Newey.

R. W. Fairbrother Ltd. 5.3.59. 109 Norfolk St., Wisbech, Cambs. Mnfrs. of and dlrs. in chemicals, gases, drugs, etc. £1,000. Dirs.: R. W. and Mrs. A. E. Fairbrother.

David Swerling and Co. Ltd. 6.3.59. 59 Pin Mill Brow, Ardwick, Manchester. Mnfg. pharmaceutical chemists, etc. £5,000. Dirs.: D. and Mrs. Z. Swerling.

O. H. Harding Ltd. 6.3.59. 246 Wickham Rd., Shirley, Croydon. Chemists, pharmacists and druggists, etc. £2,000. Dirs.: M. and W. Servian.

Binghams (Bournemouth) Ltd. 6.3.59. Waterloo Chmbrs., Fir Vale Rd., Bournemouth. To take over bus. of pharmacist cd. on at 57 Westover Rd., Bournemouth, by W. M. Bingham. £2,000. Dirs.: W. M. and Mrs. C. J. Bingham.

J. Blau (Chemists) Ltd. 9.3.59. 350 Eastern Ave., Ilford, Essex. £100. Dirs.: J. M. and N. Blau.

H. I. Weldrick Ltd. 18.3.59. 41 Hallgate, Doncaster. To take over the bus. of retail chemist cd. on at Doncaster by H. I. Weldrick, etc. £10,000. Dirs.: H. I. and Doris Weldrick, C. J. Appleby, R. Wright and B. P. Urmston.

Gramos Chemicals Ltd. 19.3.59. 78A Northern Parade, Portsmouth. £3,000. Dirs.: E. F. R. Moss and A. R. Grant.

NEW PATENTS

COMPLETE SPECIFICATIONS ACCEPTED

Miscellaneous

Synthesis of aryl and amino-substituted propanediol monoalkyl ethers, and intermediates obtained therein. *Farmaceutici Italia S.A.* 813,314.

Process for the production of N, N-dibenzylamino acids. *Uclaf.* 812,541.

N-benzylpeptides and process for their production. *Uclaf.* 812,542.

Compositions for combating nematodes. *Farbenfabriken Bayer A.G.* 812,512.

Anthrone derivatives. *Ciba Ltd.* 812,825

Substituted phenoselenazine compounds. *Smith Kline and French Laboratories.* 814,065.

α-Amino acids and peptides derived therefrom. *Uclaf.* 812,543.

Substituted chlorophenoxyacetic acids. *Société des Usines Chimiques Rhone-Poulenc.* 813,367.

10-(aminoalkyl)-trifluoro-methyl phenothiazine derivatives. *Smith Kline and French Laboratories.* 813,861.

α - Benzyl - Y - methyl - N - trityl - L - (+)-glutamate and alkyl homolog thereof. *Uclaf.* 813,927.

Pharm ceuticals

Bismuth aluminate for the treatment of diseases of the digestive tract and process for the manufacture thereof. *Etablissements Roques.* 812,918.

Nor-tropines and nor-pseudo-tropines and process for their production. *E. Merck A.G.* 813,218.

Process for the preparation of morpholines and piperazines. *Jefferson Chemical Co.* 813,957.

Diuretic agents. *Cassella Farbwerke Mainkur A.G.* 813,430.

Therapeutic agent. *E. W. Horner Ltd.* 813,306.

Clinical dextran and method for producing same. *Commonwealth Engineering Co. of Ohio.* 813,960.

Vaccine products and methods of producing same. *Parke, Davis and Co.* 813,882.

New patents are from the *Journal of Patents*, and new trade marks are from the *Trade Marks Journal*. In each case permission to publish has been given by the controller of Her Majesty's Stationery Office. Each of the publications mentioned is obtainable from the Patent Office, 26 Southampton Buildings, London, W.C.2.

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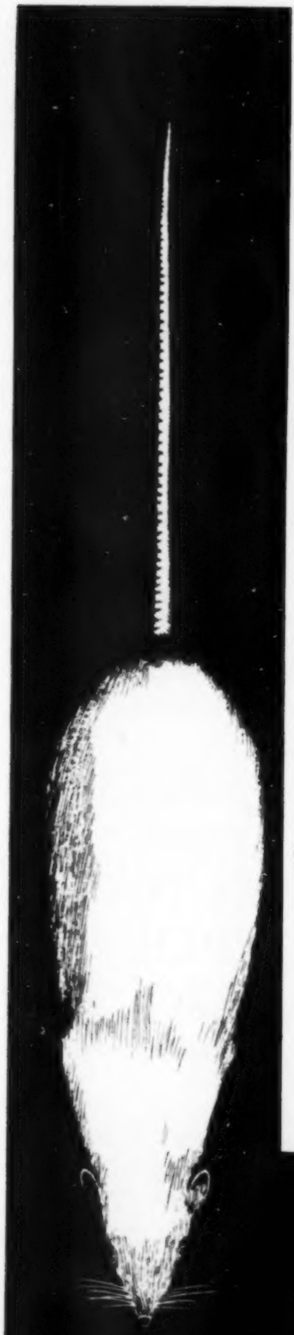

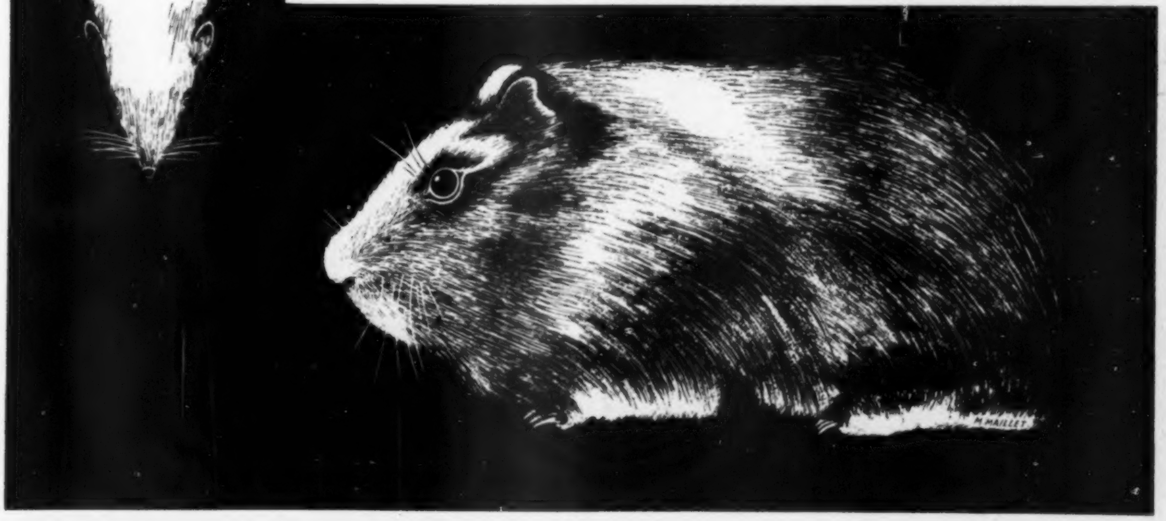

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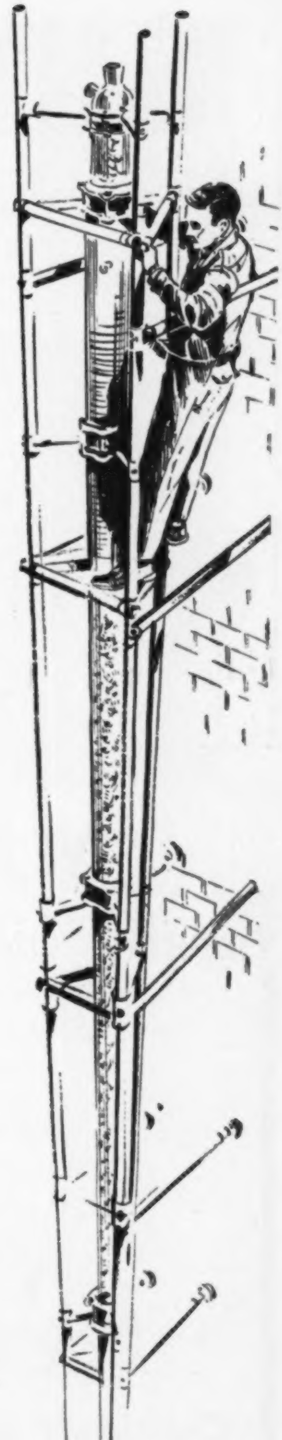

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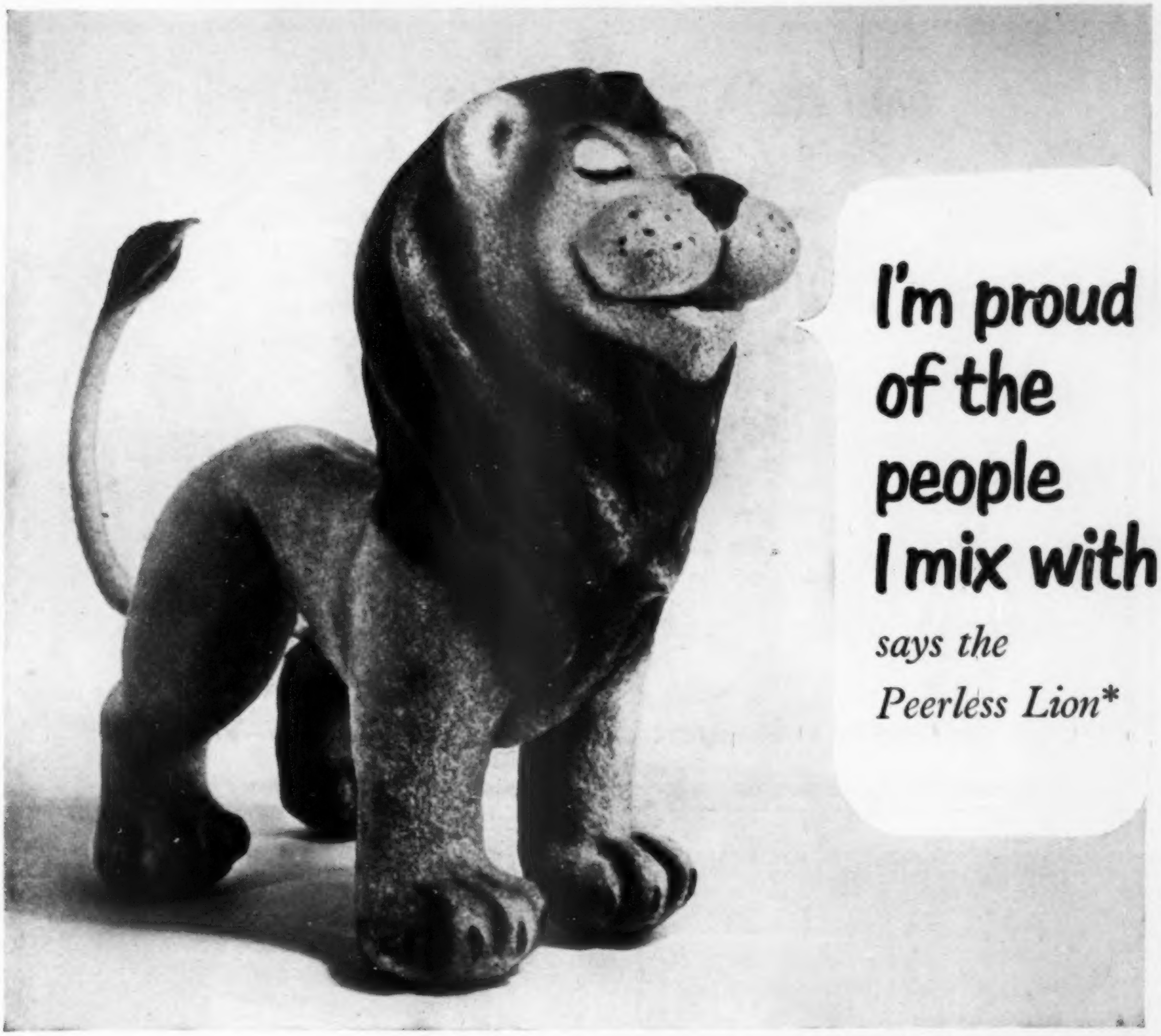

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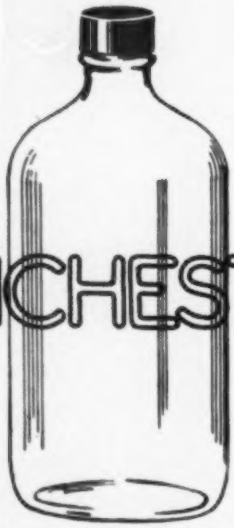

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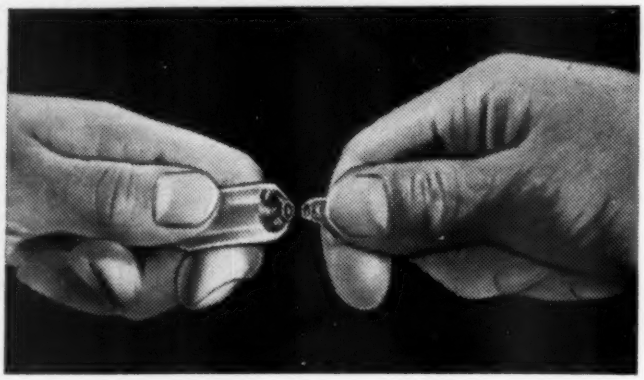

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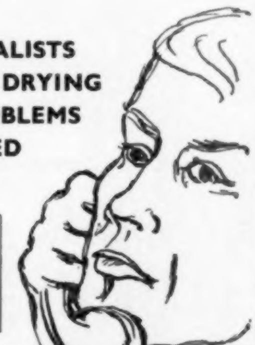

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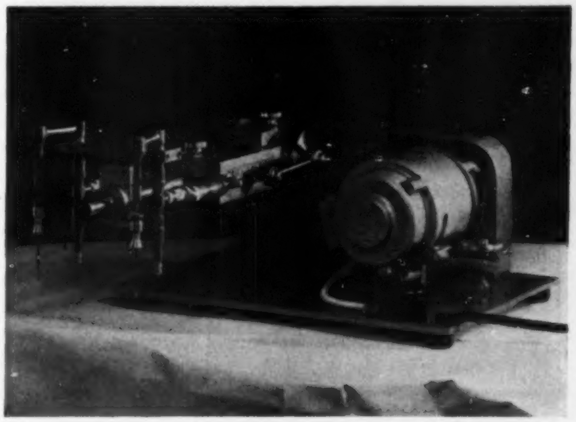

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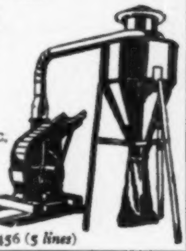

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